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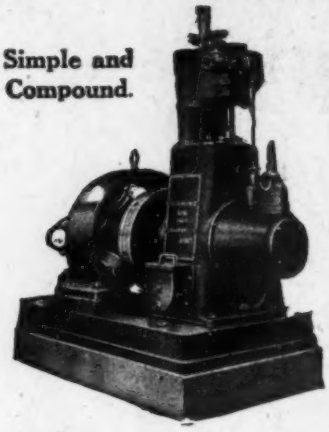

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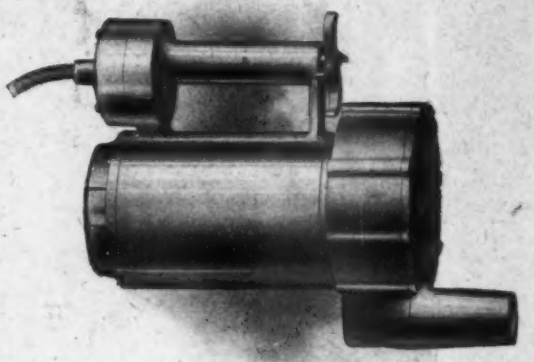

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ELECTRICAL REVIEW.

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THE WORK OF THE TRADE COMMISSIONER.

As we have on several occasions expressed here our conviction that the Trade Commissioners who, as representatives of the British Government, are stationed at important outposts listening for overseas trade information, will be able to render invaluable assistance, it will be as well if we refer to the functions of these gentlemen as they are set out in the official "letter of appointment" which they receive upon proceeding to take up their duties. We do this in order that manufacturers and traders who intend to avail themselves of such assistance should know at what point in their operations they may reasonably ask for it.

First, the Commissioner is instructed to give reasonable help to British traders *who seek his services*. It is not unreasonable to assume that those who don't ask, don't want. There is plenty of experience to prove that such a branch of public service may become more valuable if it be given an opportunity of demonstrating and adding to its usefulness. Nothing is so discouraging as want of appreciation, and we hope that the electrical and allied trades will not fail to avail themselves of efforts made on their behalf, both by these Commissioners and by the Department of Overseas Trade under which they work.

The second instruction to the Commissioners is to report upon Tariff Laws and Customs regulations and legislative proposals of interest relating to the sphere in which they operate. As times goes on, such information will become increasingly important in connection with the building up of a large export trade. Certainly not the least essential of the outlined duties is covered in part of the third instruction which is "to watch the imports . . . furnish reports on the best methods of meeting foreign competition." We need all the expert observers—whether officials of the D.O.T. or of trade associations—who can keep the Government and the traders fully informed respecting the methods, new and old, wise and otherwise, honest and dishonest, that are employed by foreign competitors, of whatever nationality, to undermine our commercial influence or defeat our legitimate aspirations. There is a danger that while trade is very active the foreign penetration methods that have been revealed to the general public during the past five or six years will be forgotten or lightly regarded. Because Germany is suffering from industrial indisposition at present we must not imagine that her schemers are asleep or have abandoned pre-war economic aims and intentions. It will be useful if capable Government Commissioners can keep their ears wide open for all movement of this kind and dispatch immediate intimation for publication here. We are not forgetting that in pre-war days readers of this journal were kept informed continuously respecting the operations of Continental electrical export traders. Our firms could not complain of want of knowledge then—somebody failed to take appropriate action to counteract the influences that were at work. We are differently placed to-day, and private trading organisations, as well as Trade Commissioners, will probably be alert for news and prepared for action. Let us hope also that if the Commissioner shows that Government action is necessary the State will not leave private action unsupported. The Commissioners through being in touch with British traders in their sphere of influence, will be able to pass on the views of these commercial men regarding the best methods to be employed to meet foreign competition.

The fourth function of the Trade Commissioner's Office is to forward early information as to contracts open or in prospect, probable extensions of public works, and the opening of new industries. Already the D.O.T. is performing useful service in this way, but it can, and we believe will, do a great deal more, using the channels afforded by the Press to secure publicity among all British traders interested. Needless to remark, telegraphic means should be employed in order to avoid the waste of valuable time in the transmission of information which can only be of service if it is received in good time.

There are many other functions of the Commissioner, such as the preparation of reports on trade conditions, available supplies of raw material, labour and economic conditions, and last, but by no means least, the furnishing of details as to the cost of living. In this last matter there is not likely to be stability for a long time to come, but many men will be going abroad to take up technical and trading situations during the next few years, and the possession of tolerably reliable information respecting local conditions, including the cost of living, is very necessary when they are fixing up the terms of their engagement.

Electrical Development.

"During the war, the Society for Electrical Development was obliged to restrict its activities, although it continued throughout to do all its curtailed budget permitted, and carried on sufficiently to justify the subscriptions of those members who supported it. During the past three months so many of the big companies have resumed their membership . . . that the funds available for the Society's work are over 50 per cent. greater than at the time of the November meeting of the board of directors.

"Greater activities will be undertaken as justified by the increased revenue, and it is now desired to line up the entire industry in support of the very important work being carried on and contemplated. This work has for its main feature the education of the public to an appreciation of the uses of electricity for domestic and power purposes. No other organisation is equipped to render this important service, the value of the continuation of which is far greater than the cost to the industry."

We quote from a circular recently issued by the Society which has done such wonderful work in the United States, and we wish to emphasise the fact that after all the years that it has been engaged in educating the public "to an appreciation of the uses of electricity for domestic and power purposes," it still finds abundant scope for its lively propaganda, and, far from relaxing its efforts, is embarking upon a still broader programme of activity.

If this is the case in a country where, for various reasons, the popular use of electricity has been developed far beyond the stage attained in any other, what are we to say of this country, which has only recently awakened to the possibilities and advantages of the electrical way of doing things? We believe that here we have only scratched the surface of what is practically a virgin field; the prospects before the electrical industry are of the rosiest hue—provided the field is tilled with skill and energy. To carry out that purpose the British Electrical Development Association was formed less than two years ago, and under the guidance of Mr. J. W. Beauchamp it has already made its influence felt in many directions—but, as in all such cases, its capabilities are in strict proportion to the funds at its disposal. We therefore urge our readers to take their cue from the American Society, and to provide ample ammunition for the use of E.D.A.

U.S.A. Transport Problems.

The *Electric Railway Journal* for February 21st, 1920, prints a piece of publicity literature issued on behalf of the motor-'bus interest, and entitled: "The Street Car Trust Co." It is urged on behalf of the 'bus that it means faster service, since the failure of one vehicle does not mean holding up all the others that are behind it; while the stopping-places can vary, so that one 'bus can load up at one street-corner, and the next can pass it and load up at another convenient spot.

It seems recently to have been discovered by those responsible for the regulation of the traffic in London, that it is desirable to have fixed stopping-places for 'buses as well as for tramcars. This fact, as well as several others facilitating the navigation of the streets, had been recognised in Berlin long ago. The convenience of optional stops is largely a theoretical consideration, and in actual practice it is apt to be discounted by the Nelsonian tactics of the driver, who will invariably pass those who seem unable to help themselves, and will endeavour to avoid stopping to pick up the more self-assertive.

The reprint also claims cheaper operation for the motor-'bus, and on this point our contemporary has some very pertinent observations to make. "Even in places where they fit, 'buses cannot make any profit on a 5-cent fare, except on a very short haul. Even at a 10-cent fare the margin of profit is not what would induce a stampede of would-be investors. Nor do any of these estimates of cost take into account that in some future day the municipalities are going to get tired of paving streets for the benefit of a private 'bus corporation."

We have before expressed the opinion that the whole system of flat fares is wrong, and that our British standard method of differentiated fares (called in America the "zone" system) is right; and we believe that trans-Atlantic street-traffic operating companies will never get out of the morass that their technical Press shows them to be in until a general change in their fare system is brought about. But, as we have also pointed out, it is entirely unfair to saddle a tramway with the upkeep of the whole of the roadway between the tracks—which it does not use, since the cars run on the rails—while the 'buses get off scot-free.

Bath-room Dangers.

The tragic fate of a woman who used an electric hair-drier in the bath, which we recently reported, serves to emphasise the importance of circumspection in the choice of electrical equipment for the bath-room, which is the subject of current correspondence in our columns. It is the proud and justified boast of electricity that it is by far the safest illuminant with regard to fire and life, and the conditions which usually obtain in dwelling-houses are fortunately such as to render the possibility of a fatal, or even an alarming, shock exceedingly remote; it would be difficult to collect the records of as many as five fatalities in private houses in the past 20 years.

The bath, however, is the one spot in the household where the conditions are highly favourable to shock, and it is impossible to exercise too much care in the selection and installation of electrical apparatus in the bath-room; the water in the bath is always well earthed by the drain pipe, and often by the water-supply pipes, and the occupant of the bath is ideally situated to receive a fatal shock if contact is made with a faulty metal switch-cover or an electrical appliance which is in contact with the circuit.

In the case at St. Anne's, it was indeed doubtful whether electricity had played any part in the tragedy; the victim was known to be liable to fainting fits, there was no evidence that she received a shock at all, and the verdict was death by drowning; but the fact remains that she had been using an electrical device, which was found lying in the water. In our issues of February 18th, 1916, and September 5th, 1919, we recorded cases in which there was no question that the cause of death was electric shock in the bath, and on February 25th, 1916, we drew attention to the dangers of experiments in the bathroom. By using suitable fittings, keeping all switches, &c., out of reach from the bath, and warning householders not to use electrical devices in the bath, the risks can be practically eliminated.

Electricity Supply.

As we go to press, we learn that the promised—or threatened—Bill to provide the District Boards and Electricity Commissioners with compulsory powers, which were dropped in the House of Lords last year, has been introduced into the House of Commons by Sir Eric Geddes. There is no doubt that the measure will meet with fierce opposition.

THE NEW BAKERLOO ROLLING STOCK.

That new rolling stock for the London Underground Electric Railways has been on order for some considerable time is a well-known fact, and the various reasons that have prevented delivery need no elaboration. It will suffice to record that certain new stock has recently been put into service, and that it is hoped to receive delivery of more in the near future.

Not long ago we were privileged to inspect some new London and North-Western and London Electric Railway joint stock, of which details and illustrations are given below. One of these new trains was put into service on the Elephant and Castle-Watford line of the Bakerloo Railway shortly before Easter. A second train is now also completed, and it is anticipated that others will be ready for running at frequent intervals until 10 complete trains are in operation.

The trains in question were designed and ordered in 1914, but, owing to the war and subsequent labour troubles, delivery from the makers, the Metropolitan Carriage, Wagon, and Finance Co., Ltd., of Birmingham, is only now being made. This fact accounts for the retention in the trains under discussion of certain features in the electrical equipment which it has been decided to dispense with in subsequent designs of new stock. We refer more particularly to the control gear, a new type of which, we understand, has been in experimental use for some time past, and has shown promising results.

We were recently afforded an opportunity of travelling on one of these trains during trial runs, the object of which was to heat up the electrical equipment prior to the high-pressure tests being applied at the Ealing Common Works. Although the train with which we are concerned had never before run under its own power, a very creditable performance was made and everything worked perfectly. The train is capable of attaining a normal speed on the level of 48 miles per hour. A feature of the train is that it has three motor cars, one being central, and one at each end. This gives more even haulage and acceleration up to full

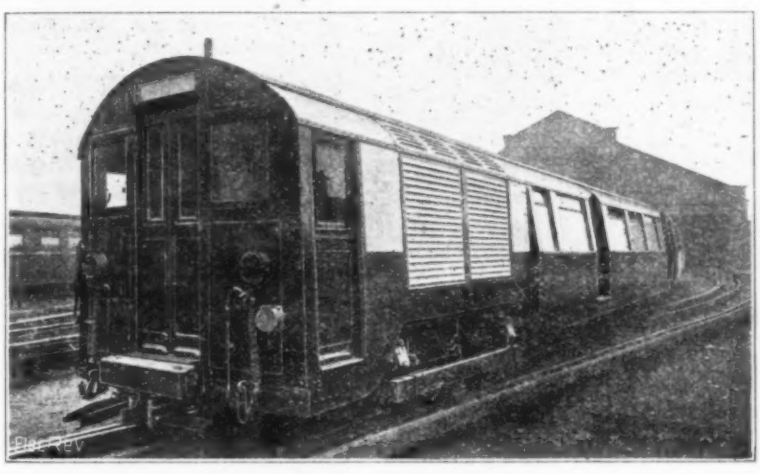


Fig. 1.—New Bakerloo Motor-car.

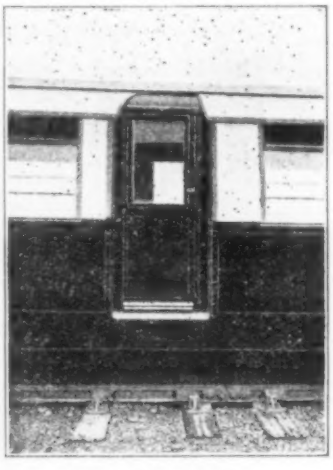


Fig. 2.—Side Door.

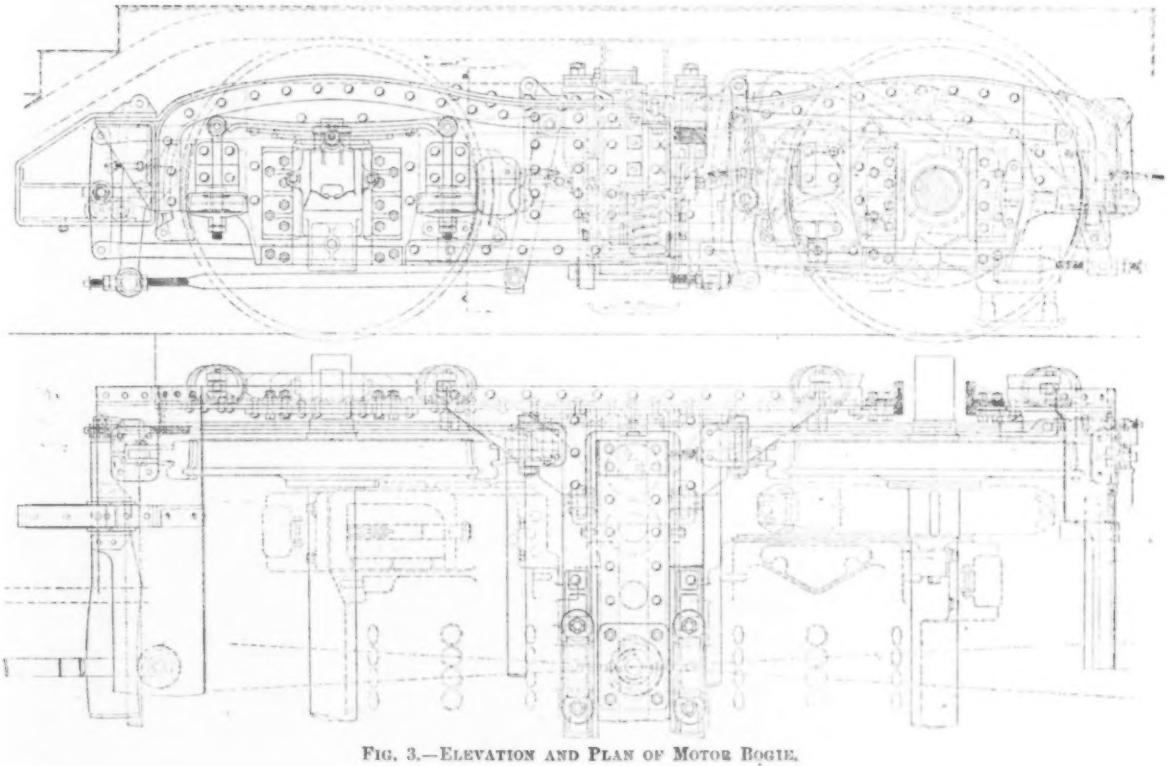


Fig. 3.—Elevation and Plan of Motor Bogie.

speed a few moments after starting. Another improvement is the enlargement and strengthening of the buffers between coaches, so that they are made to take up all pushing strains, leaving only the pulling strain to be taken by the draw-bars; formerly the latter took up both pushing and hauling strains.

The train consists of six cars—three motor-cars, and three trailers—in place of five on the old trains; the motor and trailer trucks are built up on the angle-iron and plate

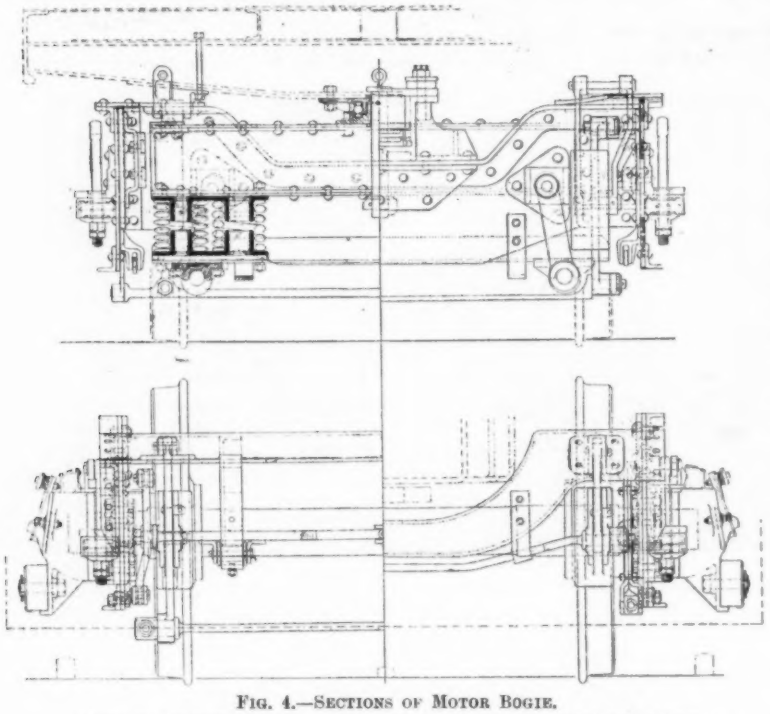


Fig. 4.—Sections of Motor Bogie.
Above: Section through Bolster, and at A B, fig. 3; below: Inner and Outer Headstocks.

principle, with laminated side and coil bolster springs. The general arrangement of the motor-car and truck is shown in figs. 1, 3, and 4, while a view of the trailer-car is given in fig. 5. The cars are constructed throughout of steel, with a minimum of wood interior finish. The leading dimensions are as follows:—Length over all, 50 ft. 10 in.; width over body, 8 ft. 8 in.; total height from rail, 9 ft. 5·25 in.; centres of bogies, 34 ft.; wheel base of motor bogie, 7 ft.; and wheel base of trailer bogie, 6 ft. The diameter of the motor wheels has been increased by 6 in. to 42 in., and that of the trailing wheels by 2 in. to 32 in. The total weight of a six-car train when unloaded is 161 tons 2 cwt.

The air compressor is of the C.P. 30-A type, manufactured by the British Thomson-Houston Co., Ltd., and the brake equipment is of the Westinghouse pattern with quick-acting triple valves. The brake blocks are of unchilled cast-iron, and the brake rigging on the trucks is of the clasp type. It is noteworthy that this is the first rolling stock on the London Underground railways that is fitted with double brake blocks.

Each car has a vestibule, and to facilitate quick exit and entry, in addition to the end doors, each has a central door, as shown in figs. 2 and 5, which is locked by an electrical contrivance as soon as the gateman operates his levers. The locking and unlocking of the centre door is under the control of the gateman, the door itself being an ordinary swing one, checked by a standard design of door check mounted under the car floor. Embodied in the pedestal which holds the mechanism for operating the end car door, fig. 6, is a switch which controls the circuits governing the electrical lock of the centre door. When the gateman opens the end car door, he automatically unlocks the middle door, and this fact is made plain by a red lamp, A fig. 6, in the pedestal supporting the end door mechanism, becoming illuminated. When the end door is again shut, it closes the circuits which lock the middle door, and a green lamp in the pedestal becomes illuminated. Should, for any reason, the end door be shut and locked before the centre door has been properly fastened, the red lamp in the pedestal will continue to burn until the door has been properly locked.

It will be noticed from figs. 2 and 5 that the car doors have been built to conform to the curvature of the roofs of the cars. This fact necessitated the use of a door that opens inwards in place of the usual sliding type, because the latter would have allowed too little head room, and would have had to be placed further back, thus leaving a large outside step. We understand, however, that a new type of sliding door is being experimented with, by the use of which it is hoped to overcome some of the difficulties referred to above.

The number of seats in each motor-car is 36, and that in each trailer car 48.

In order to provide for the difference in heights between the Bakerloo and London and North-Western stations, the floors of the cars of the new trains have been raised 4·5 in. higher than those of the old stock. Consequently, at first sight the cars appear to be cramped for space, but ample head room is provided inside the cars, and the interior has been so arranged and decorated as to make it appear as large as possible.

(To be concluded.)

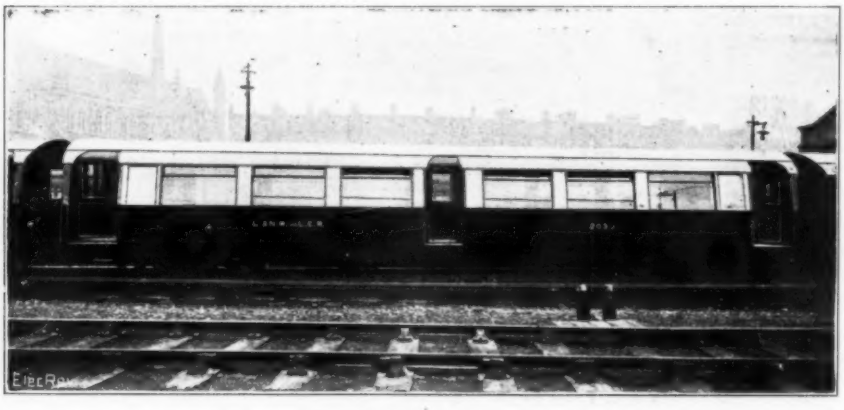


Fig. 5.—New Bakerloo Trailer Coach.

Fig. 6.—Electric Door Control Mechanism.

THE "ELECTRICAL REVIEW" PROGRESS CURVE.

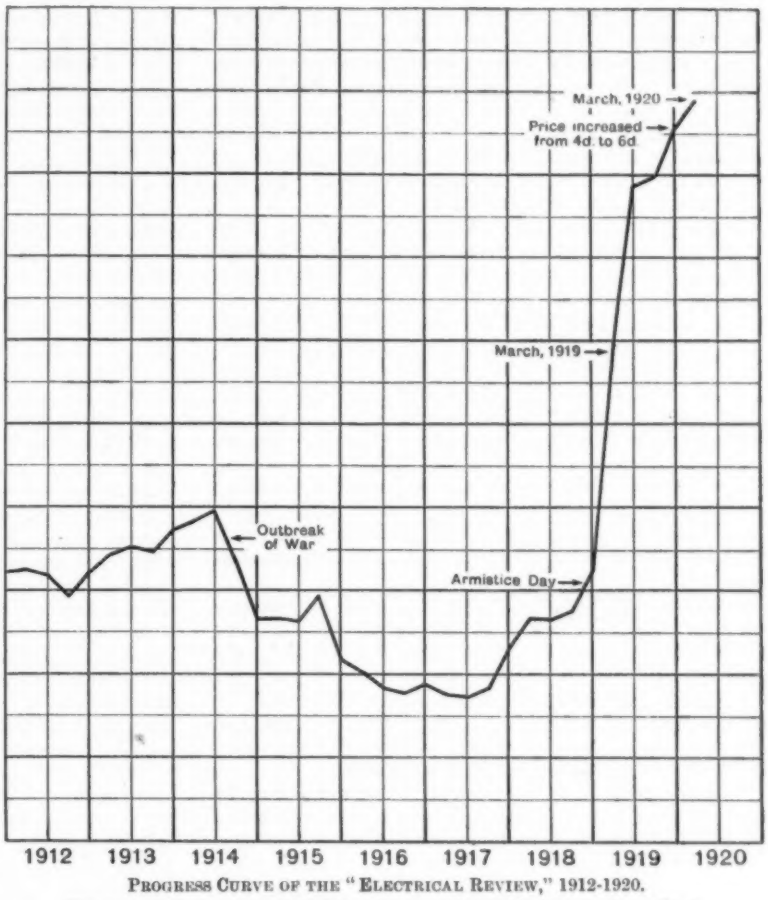
PAID CIRCULATION ONLY.

LAST year, under the title "The ELECTRICAL REVIEW and the War," we published a curve showing how the monthly sales of the journal varied, and gave an account of our experiences during the war.* At that time the "paid circulation" of the REVIEW (the *net paid* circulation, exclusive of all exchanges, voucher copies, &c.) was increasing at a phenomenal rate, and showed signs of running off the map.

We now reproduce the diagram, covering the same period, with the addition of the past 12 months.

In this instance, for convenience, the quarterly figures are given, instead of the monthly ones, but in all other respects the data are identical, and the same base-line has been used. It will be seen that the steepness of the curve was maintained up to June, 1919, when, as always happened in the summer in pre-war days, there was a lull in the demand; in the winter, however, the curve again became steep, and the long-deferred, but unavoidable, increase in price hardly affected the slope at all, for there is always, in normal times, a slight break of line at the New Year (*cp.* 1912-13 and 1913-14). The drop during 1914-16 has been made up for 3½ times since 1917.

* ELECTRICAL REVIEW, April 4th, 1919, p. 372.



PROGRESS CURVE OF THE "ELECTRICAL REVIEW," 1912-1920.
The curve is drawn to scale, but the lower portion of the diagram is omitted.

CAPITALISTS ALL!

By H. R. TAUNTON.

(*Continued from page* 454.)

So far, indeed, we have not gone beyond a point on which most modern thinkers are agreed, in principle. But when it comes to practice, your capitalist shirks the logical conclusion, and your labour man jumps to illogical ones. Your capitalist proffers bonuses, and grudging schemes of profit-sharing—always with a limit. Sops to Cerberus! He would give a little, but not too much. He is desperately fearful lest his employé's share of the profit should be in any way comparable with his own. "So much you shall earn," he says in effect, "and if you work very hard (and increase my earnings tenfold) so much more. Not too much, of course—just a little more." Always a limit!

At the other extreme your Labour man wants nationalisation, with its attendant waste and inefficiency; socialism; communism. He would ignore money, and drive it out of the country, throwing away a useful and essential tool. For the rest, share and share alike; the muscles of the labourer, whose job could be done by a thousand others, are to be valued at the same figure as the trained and experienced brains of the manager, one in a thousand.

The capitalist would give unequal reward to equal merit; the Labour man, as unjustly, equal reward to unequal merit. The happy mean is obviously to make the reward proportionate to the merit. So obvious, so elementary! And yet so difficult to translate into workaday practice!

Let us attack the problem in the light of that one bright little maxim—reward proportionate to merit—which crystallises the whole issue between Capital and Labour. Harking back to our typical firm of dynamo manufacturers, consider the different members thereof in their new aspect of shareholders, capitalists all, whatever shape their contributions to the common stock may take. Our first task is to assess the value of their respective contributions; that is to say, the proportions in which they are to share in the profits.

Take first—first because he is most easily disposed of—the preference shareholder. His contribution is simply money. He takes no part in the use of it, for good or ill; he sits passively waiting for his dividend. He uses ordinary common sense in his original selection of an industrial investment, and he knows he is almost as sure of getting his dividend as if he had invested in a gilt-edged security. The little more risk is fully compensated for by the higher rate of interest. The directors of the company naturally fix that rate at the lowest figure which will attract the necessary money, having regard to the special factors of their particular case. We may take it, therefore, that a preference shareholder is fairly compensated for his contribution

to the common stock of the company by the payment of the agreed rate of interest. However the company may flourish, he deserves no more, for he does nothing to help to make it flourish. In practice, of course, he gets no more; and he is the one class of shareholder who is, at present, paid strictly according to his merits.

It will be convenient, therefore, to take his remuneration as a standard by which to compare the remuneration received by, or due to, the other members of the firm. To take the concrete example of our dynamo manufacturing firm, that remuneration will be at the rate of, say, 8 per cent. per annum (which seems to be a favourite figure nowadays) on each member's capital, whether cash or its equivalent.

Dealing next with the ordinary shareholder. Like the preference holder, he contributes nothing but money. True, he may attend the general meeting, but his part there in moulding the policy of the company is negligible. He may criticise, but his criticism is rarely constructive, and still more rarely effective.

But he differs from the preference holder in this, that he takes a risk. If the company does badly, he receives a small or no dividend; and in the case of the company failing he loses a part or all of his capital. He is willing to take that risk on the chance of receiving dividends bigger than those of the preference holders, and obviously it is only common justice that he should have that chance. And, of course, without it, his contribution to the common stock would not be forthcoming.

The ordinary shareholder, then, should be remunerated for, first, the use of the money he invests. For this he should receive the standard rate received by the preference holders; *i.e.*, in the present case, 8 per cent. per annum. Secondly, he should be remunerated for the risk he is willing to take of receiving less than that standard rate. His extra remuneration under this head can be more conveniently considered later.

We now come to the directors. They are generally large shareholders, and in that capacity are entitled to the same remuneration as other shareholders. But they are also salaried employés of the firm, contributing capital other than their money—their brains and energy, their knowledge and experience—all those qualities, in a greater or less degree, which go to make the successful business man. In this respect they resemble every other paid employé in the firm; and the problem, therefore, of their due remuneration for the higher form of capital which they introduce into the common stock, is one with the general problem, the essential problem, of the fair remuneration of the employé as distinct from the shareholder.

We will leave the directors for the moment, and descend to Brown, a fitter in the engineering shop. He shall be our typical employé. Brown is a healthy young chap, steady and straight, strong, intelligent, with a certain amount of technical knowledge, and specialised skill in the use of certain tools for certain purposes. Without that skill and knowledge, without his character, his health, strength, and intelligence, he could not earn his living. They are his capital. With it he can always earn a dividend, though he start without a penny in his pocket. In which, of course, he has the advantage over the man whose only capital is money, which will never earn him a penny without the aid of his own, or someone else's brains or muscles.

Brown, therefore, blessed with this valuable capital, takes it to the best market, and gets a job in our firm of dynamo makers. He invests his capital in that firm; and he receives a dividend on it, drawing his pay, pretty accurately fixed by ruling labour conditions.

Let us say he makes an average of £200 a year. The company is paying him £200 per annum in money, the lower form of capital, for the use of the higher form of capital he has contributed to the common stock.

Now, if it be agreed that his capital is at least as valuable and essential as that introduced by the shareholders—we have in fact shown that it is more so—it is obvious that for the use of it he is entitled to remuneration at not less than the standard rate paid to the shareholders for the use of theirs. This we are assuming is 8 per cent. per annum. On this basis, therefore, it is clear that if he is worth £200 a year to the firm, the value of the capital he has invested in it, and for the use of which they pay him, is not less than £2,500.

He is a capitalist, an investor, a shareholder in the firm to that amount; quite as much so as the holder of £2,500 of 8 per cent. preference shares.

Here we can leave Brown in his unexpected glory; for what is true of him is true of every other employé. Capitalists all! All shareholders in the firm to the extent of their annual earnings capitalised at 8 per cent. The office boy at 10s. a week is a shareholder of £325; the manager at £500 per annum is another, at £6,500; and the managing director at £1,500 per annum is interested to the extent of nearly £20,000 more than the value of his ordinary shares.

(We are assuming, of course, that each is paid what he is really worth to the firm, which is not always the case. But of that more anon.)

That this is no false or exaggerated estimate of the value to the firm of its individual employés can be sufficiently proved. Suppose a firm were given the opportunity of dispensing with their managing director, making shift without any head to their organisation; and instead, using the salary they would save in paying the interest on, say, £20,000 of new capital. Would they do it? Of course not! They know full well their £1,500 a year is far better spent on the services of their managing director than in paying the interest on that amount of capital. To take the other extreme. What reasonable firm would elect to pay the interest on £300 of new capital rather than pay 10s. a week to an office boy. The inconvenience of doing without even his small services would not be worth the use of the £300. In other words, his capital value to them is at least that.

To emphasise the point, at the risk of tediousness, let us suppose the good old days of slavery returned. Would our firm of dynamo manufacturers not congratulate themselves on a good bargain if they could buy a skilled fitter for £2,500, body and soul, for the rest of his useful life, without any further payment of wages? Or an experienced manager for £6,000; or a junior clerk for £700 or £800?

Admitted then that each employé is a shareholder in the firm to the extent of at least the capital value of his services, we are confronted with the fact that by far the larger portion of the firm's working capital, and that the more important kind, is held by the employés, and not by the nominal shareholders. In different kinds of businesses the proportion varies. But a firm with a nominal capital of £250,000 may easily have a pay roll of £80,000 a year. Capitalising this at 8 per cent. we arrive at the conclusion that for every £1 of the lower form of capital, money, contributed to the undertaking by the shareholders, the employés contribute £4 worth of the higher forms of capital: enterprise, energy, experience, skill, strength, and so on.

Our firm is a prosperous firm. At the end of the year it finds itself, after payment to the preference holders, and a prudent allocation to reserve, in a position to declare a dividend of 20 per cent. on the ordinary shares. The ordinary shareholder gets, therefore, £20 for every £100 he has invested. Agreed that he is entitled to £8 for the simple use of his money, the standard rate paid to the preference holders, he is clearly receiving £12 in consideration of the slight risk he takes of receiving less than that rate.

That is his sole additional merit, his only claim for special consideration, as compared with the preference holder. But what of the merits of the employés? What of their claims?

(To be continued.)

NOTES FROM CANADA.

(From Our Special Correspondent.)

Water Power Statistics.

The latest estimate of the total available Water Powers of this country as given in the annual statement of the Commission of Conservation is 18,832,000 H.P., of which Quebec has 6,000,000, Ontario 5,800,000, British Columbia 3,000,000, Manitoba 2,707,000, while the remainder is credited to other parts of this Dominion.

The estimated possible powers in populated areas amount to 9,781,400. In this section Ontario heads the list with 3,800,000, Quebec is next with 3,507,000, and British Columbia is third with 1,300,000. The total horse-power so far developed is 2,383,240, with Ontario again in the lead with 1,000,000, then Quebec with 900,000, and British Columbia with 310,000.

More than 85 per cent. of the total electric generating station capacity in Canada is derived from water power, the remainder being nearly all steam power, but even of this a considerable proportion is in the form of steam plant installed in conjunction with hydroelectric plant, and used merely for stand-by or auxiliary purposes. Forty-one per cent. of the total capacity is in plants of 100,000 H.P. or more, and 43 more is in plants ranging in size from 10,000 to 100,000 H.P.

Last year there was completed, in various parts of the Dominion, the installation of plants aggregating 64,000 H.P., and plants at present under construction total over 370,000 H.P., and other developments definitely contemplated for the near future will add some 750,000 H.P. Thus there will soon be available, within the next two or three years, over 3,000,000 H.P., or about one-third of a horse-power for each inhabitant of the country.

In Ontario and Quebec two very different methods have been developed for dealing with the water powers, but each appears to be working out well in its own area. In Ontario the Hydroelectric Power Commission of Ontario has jurisdiction over all water powers so far as future developments are concerned, and controls nearly all the existing ones; the Commission has adopted the policy of carrying out its own developments and operating them subsequently.

In Quebec, the Quebec Streams Commission is building dams, and taking all necessary steps to make water power available for use by private companies, but these latter obtain leases for the use of the water, build the necessary generating plants, and operate them.

The report, referred to above, from which these details are taken, remarks that it has recently been stated in connection with the Gouin Government reservoir on the St. Maurice River, which stores 160,000,000,000 cu. ft. of water, that the capacity of the Shawinigan and Grand Mere plants is soon to be raised from the present 330,000 H.P. to about 600,000 H.P.; this is in the Province of Quebec. In Ontario there is the Queenston-Chippawa Department of the Hydro-electric Power Commission, where 200,000 H.P. will be available in 1921, and the necessity for providing more power than this is already apparent so that the question of increasing the capacity of this great development to 1,000,000 H.P. is already under discussion; the existing station is being designed for a capacity of 450,000 H.P., to be obtained from 10 50,000 H.P. units, one being spare.

It was stated not long ago that Representative Clarence MacGregor, of New York, had made a proposal to the State Department of the United States for a new treaty to be made between the U.S. and Canada to provide for the diversion, for power purposes, of an additional 60,000 cu. ft. per second of water from the Niagara River. At present the allowable diversion is 56,000 cu. ft. per second, 36,000 for Canada and 20,000 for the U.S. Mr. MacGregor proposes that each country should have 30,000 cu. ft. more than its present allowance.

Power or Scenery?

It seems likely that before long there may be a stiff fight in regard to the amount of water that may be diverted from Niagara, between those who argue that the scenic beauty of the falls is the paramount consideration, and those who with no less emphasis declare that the demand for power is becoming so insistent that it will have to be met, scenery or no scenery. The proposal of Mr. C. P. Steinmetz, of the General Electric Co. in the U.S., that all the water that it is possible to take for power purposes should be so utilised, and that the falls should be available as a spectacle for visitors on Sundays, when the load on the generating plants would be light, although it was looked upon as a sort of joke at the time it was made a few years ago, is now being considered as a possibility of the future.

Telephone Developments.

Telephones, as most electrical men know, are used much more extensively on this continent than in England, and the shortage of materials has compelled the Bell Telephone Co., of Canada, to state, at any rate with reference to some of the larger towns, that in future only two-party lines will be installed. Under this system, of course, while each subscriber can be called separately, either can overhear the conversations of the other, so that strict privacy cannot be secured. At the same time there are many instances where neighbours are sufficiently well acquainted not to mind such conditions very much. A recent newspaper report of a meeting of the Engineering Institute of Canada, quotes one of the engineers of the Automatic Electric Co., of Rochester, New York State, as saying that his company has an order from the Bell Telephone Co., of Canada, for $25,000,000 worth of equipment, and that New York, Boston, Buffalo, Calgary, Vancouver, Winnipeg, and many other places are now using the automatic telephone.

Sir Adam Beck Back.

Sir Adam Beck, chairman of the Hydro-electric Power Commission of Ontario, is back again in Canada after a holiday of two months or so in England. He has recently stated that when the Queenston-Chippawa scheme at Niagara Falls is completed in 1921 there will be available 165,000 H.P. from three generators of 55,000 H.P. capacity each. Later, there will be nine generators altogether having an aggregate capacity of 500,000 H.P. An order for 15 15,000 K.V.A. transformers, 12,000 to 110,000 volts, has just been placed by the Commission, as well as for two more 55,000 H.P. generators, making five in all of the latter now on order.

REPORT ON THE ELECTRIC LAMP INDUSTRY.

The following reply to the Report of the Board of Trade Committee on Trusts has been received from the Electric Lamp Manufacturers' Association of Great Britain, Ltd. A copy of it has been sent to the Prime Minister. The statement is dated March 31st, 1920.

Electric Lamp Industry.

The manner in which the findings of the sub-committee appointed by the Standing Committee on Trusts in connection with electric lamps have been reported in the public Press, conveys an erroneous impression. We therefore think it desirable to call attention to certain findings of the committee which are in danger of being overlooked, and to point out some actual errors in the report.

The committee states, on page 15 of its report: "Since the beginning of the war, the price to the public of the standard vacuum lamp has been increased by about 26 per cent. As the general retail price of all necessaries has risen during the same period by 125 per cent., it follows that the price of electric lamps has been advanced much less than the price of commodities generally."

It further states: "It must be agreed that, had the price of lamps been uncontrolled by any association, or had the association so desired, a much higher retail price could easily have been obtained. We are satisfied that during some periods of the war, in view of the limitations of imports, the association had a stabilising influence on electric lamp prices in the United Kingdom."

The committee also admits that the average profits of the Association firms per standard lamp have dropped from 9.5d. in 1913 to 4.7d. in 1919.

The following table extracted from the report shows the great increase in cost of production of the four original Association firms. The prices received by manufacturers for the same years are also shown.

	1913 (pence).	1919 (pence).
Labour cost	1.9 ...	4.0
Materials cost	3.6 ...	9.9
Overhead factory charges	1.9 ...	2.2
Selling charges	3.7 ...	5.1
Total factory and selling costs ...	11.1 ...	21.2
Average price received by manufacturers	20.6 ...	25.9

It appears then that in spite of greatly increased costs of production our prices have only risen about one-fifth as much as the general rise of retail prices, while our rate of profit has decreased by more than 50 per cent., and this in spite of the fact that much higher prices could have been obtained.

In further amplification we append here a list of retail prices from the beginning of the metal lamp industry, showing the reductions made in the price to the consumer as and when it was found that, through some improvement or new process, the cost of production had dropped.

Standard Lamps.

	High voltage. s. d.	Low voltage. s. d.
1907	6 0 ...	4 0
September, 1908 ...	4 9 ...	3 6
June, 1909	4 3 ...	3 0
March, 1910	4 0 ...	2 9
September, 1911 ...	3 0 ...	2 6
September, 1913 ...	2 8 ...	2 2
April, 1917	3 0 ...	2 6
December, 1917 ...	3 6 ...	3 0
April, 1920	3 6 ...	3 0

What, then, are the committee's charges?

Trading Agreements.—The principal charge of the committee is that the trading discounts received by factors and retailers are considerably higher than is necessary; that by means of these discounts the Association controls factors and retailers, fixes prices at all stages, and regulates output; that the prices so fixed become the standard prices for all lamps sold in this country, and that although non-Association makers sell to the trade at a lower price than Association firms, the advantage on these low-priced lamps goes merely to the distributors who sell to the public at the standard prices.

We deal with these statements one by one.

The average discount in the lamp trade to-day is not higher than the average discount on other electrical supplies.

In the second place, the committee has seriously misrepresented the effect of our trade arrangements.

The committee suggests that every trader whose net purchases entitle him to a discount of 30 per cent. or more, must sign the factors' agreement, the particular feature of which is that the trader agrees not to sell other than Association makes.

In point of fact no trader signs this agreement, it is only signed by factors who are in effect exclusive agents for Association lamps. There is nothing unusual or harmful in an agreement with a wholesaler that he shall not sell another maker's goods; moreover, there are only 54 factors who have signed this agreement.

No other agreement is entered into which forbids the sale of non-Association makes.

With regard to the price of non-Association lamps to the public, there is nothing to prevent the trader buying non-Association lamps, should his customers desire them, and selling them cheaper than Association lamps.

Manufacturing Licences.—The second main charge against the Association is, that it has been created primarily in the interest of three large firms who have imposed onerous conditions upon other firms, *e.g.*, limitation of output in regard to licences granted under their patent rights, and stipulations that the validity of their patents should not be disputed.

It should be remembered that the Association business is mainly founded upon patent rights. The patent is a legal monopoly which is granted for reasons of public policy, and the patentee should not be attacked on the ground of this monopoly, provided that he puts it to reasonable use.

We maintain that there is nothing unreasonable in a patentee imposing upon those to whom he grants a licence, which he is not in any way bound to grant at all, conditions as to the amount which they are to produce in competition with himself, and as to the admission by them of the validity of his patent rights.

Moreover, the committee does not seem to have considered that when the Association came into existence the resources of the three patent-owning firms were sufficient to build factories big enough to meet the demand of the country, and they could ultimately have shut down all the existing lamp works, their original patents having stood the test of litigation through the House of Lords. They did nothing of the kind, but, on the contrary, licences were offered to all the existing manufacturers. This policy proves that the founders of the Association had not the desire of crippling, but rather desired to strengthen the lamp industry of the country.

The Dutch Lamps—An Unfounded Allegation.—The only remaining charge of importance is that in respect of one and a quarter million half-watt lamps, which are stated by the committee to have been purchased in Holland by three associated manufacturers at 3s. and sold to the public in 1919 at 12s. 6d. each.

It is finally stated that the "importers and distributors between them made profits amounting to £280,000 over and above what the committee considered reasonable."

This statement is *devoid of all foundation.*

The lamps referred to by the committee were not sold to the public, but to Government departments, controlled factories, shipyards, railways, and similar places where arc lamps had to be replaced, which latter could not be used owing to the scarcity of carbons and labour.

By chance, one or two per cent. might have drifted into the hands of the public, whereas 97 per cent. or 98 per cent. went to the large consumers, not at 12s. 6d., but at a price of about 8s. 3d., which is approximately the committee's recommendation.

It will thus be seen that the £280,000 alleged to have been taken in excess from the public by importers and distributors is the outcome of the imagination of some calculator who was not aware of the actual price charged to the consumer.

It was not to the interest of British makers to import Dutch lamps; their importation was part of the price to be paid for the assistance of a Dutch competing firm in building an argon plant in England during the war, the importance of which may not be apparent to the committee to-day, but was appreciated at the time by the Board of Trade, Admiralty, Ministry of Munitions, &c., argon being the rare gas used in half-watt type lamps. Owing to the absence of such plants, the scarcity of steel and building materials, &c., British manufacturers could not develop the half-watt lamp during the war, and yet there was a great demand for them for war work.

The Dutch manufacturers made it part of the terms for supplying the argon plant that the negotiating English firm should purchase Dutch argon-filled lamps.

Considerations Overlooked.—Before closing this statement we desire to make some observations of a general character.

It should be clearly borne in mind that in the lamp industry a new discovery may (as has happened in the past) necessitate complete reorganisation of plant, with accompanying tremendous financial charges. These must be provided for, and the conditions of trading must differ from those applicable to an industry which is based on a more stable technical foundation.

It is regrettable that the committee did not accept our invitation to visit a big lamp factory, which would have better illustrated to it what are the risks connected with the starting of a new industry based on patents. Without such a study, it could not appreciate what cost was borne by the pioneer firms in research, in purchase of patents, in the building and equipment of works, in experiments with machinery (which, in six years, had to be replaced three times), in the cost of training labour, the cost of unsaleable goods turned out faulty at the beginning through want of skill and experience, the cost of experts and patent litigation, all of which costs have been borne by the three patent-owning firms.

In this country the total lamp turnover of the Associated firms to-day is only £3,000,000 per annum, or, after allowing the charges of the distribution trade, an average of 1s. 9d. per head of our population.

What the firms have spent in research alone during the last eleven years is shown by the following extract from a letter which the Association addressed to the committee:—

"The total sum expended on (lamp research only) amounts approximately to £364,000; with a present annual approximate expenditure of £50,000."

The committee specifically omits these figures, and alleges that it has no means of knowing how much of the research expenditure has been devoted to lamps.

We would also draw attention to the question of foreign competition; the committee itself admits that without some form of combination the industry would not have been able to resist so successfully this competition of foreign-made lamps.

Harmful Methods.—One point more, and it is one of national importance. The committee, which seems to have been deliberately chosen for its lack of knowledge of the electrical industry (presumably in order to secure impartial judgment), held only nine sittings. In this short time it attempted to take, to consider, and to report upon evidence in minute detail upon a large and complicated subject. It can hardly be wondered that in such haste it has ignored the economic position of the industry in the national life, and the necessity of safeguarding a vital key industry to the nation.

It is suggested that this larger question should have been at least more fully recognised in making a report which will be considered by all competing lamp manufacturers in foreign markets as well as by the home consumer. Ill-considered judgments of this kind, when issued under the authority and direction of a Government department, cannot fail to have the most mischievious results.

I am, Sir,
Your obedient servant,
J. E. Edgcombe,
Director.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Discounts in the Lamp Trade.

Through your journal we call the attention of electrical shopkeepers to the insidious preparation of the lamp distributors to exclude the shopkeepers from their legitimate dealings in lamps.

Taking up the *Drapers' Record*, we find the three advertisements, enclosed. No. 1 is quite in order, but the others are decidedly not, as they are solely intended to get the consumer's trade direct, and consequently the shopkeepers' profit; such advertisements should only be found in the public Press and the electrical trade papers.

Speaking to a large manufacturer of electrical plant on the subject, he frankly admitted that the electrical business was not organised; it had grown rapidly, and thus haphazard, whereas in other trades there existed a definite demarcation as to supplying consumers and those who bought to sell at a profit.

Take for instance the case of an important electrical shop adjacent to a drapery emporium; the proprietor of the former required a large quantity of casement material. He went to the emporium, as it would not have been possible for him to get it from a wholesale firm (or distributor); had he in some way, however, been able to get the material from a wholesale house and the proprietor of the emporium got wind of the fact it would have been promptly put on the agenda for the next meeting of the Drapers' Chamber of Commerce, and the offending wholesaler would be threatened with the direst consequences.

Why not an Electrical Shopkeepers' Trade Council? The electrical shopkeeper in turn approaches the proprietor of the emporium re lamps; he is promptly informed that all lamps are bought direct (although the lamps are no part of the business, and are not to sell again). Now if lamps are to be sold to drapers direct, why not to jewellers, confectioners, chemists, &c., and, another step forward, to private houses? Doubtless the lamp distributors give a discount to the draper according to the size of their wants; this could be done equally by the electrical shopkeeper, with the proviso that the lamps must be delivered to the draper direct by the lamp distributors. This would not violate the agreements that exist with the Electric Lamp Association. Thus the shopkeepers would be properly organised and secure the profit that results from the transaction.

It is manifestly unfair that the shopkeeper should hold a stock to catch the minnows whilst the distributor takes the sprats and herrings.

An organisation should be formed to protect legitimate business, and the Electric Lamp Manufacturers' Association would appear to be the body for effective control.

Retailer.

Floating Power Stations.

My attention has been called to a letter by "Worried" under heading "The Ship as a Power Station" in your issue of December 28th, 1919.

I enclose a short paper by the writer on the same subject, and a small map showing the largest tin-producing areas in the world. It does not seem to have occurred to you when "Worried" wrote, that warships, though out of date for fighting purposes, may still contain serviceable and economical machinery, while not of use to passenger or merchant service. There is probably sufficient plant in Scapa Flow to supply all the tin mines and rubber estates in the world with power. I have proposed seriously to the Government that floating power stations be used at Port Swettenham, the Dindings, and Port Weld, and am shortly to interview the Government electrical expert who has just arrived to report on electric power and lighting for this country. Our coastal foundations (mangrove swamps) would be very bad for ordinary power stations; and another reason why power stations should float is that they could be moved about as demanded. Like "Worried" I do not know much about it, but I am an engineer, and some mining friends of mine have said that they cannot see anything against the scheme. I think the matter will be found worthy of serious consideration by those with close knowledge of naval vessels and electric power plant. Information about this country may be obtained from the Information Bureau of the Federated Malay States, London. As regards the electrical aspect of the country, Messrs. Hutchinson & Wayte have lately read a paper in London on the application of electricity to tin mines in the Federated Malay States.

C. E. Cumming.

Ipoh, Perak.
March 2nd, 1920.

[The strongest point in favour of the proposal, in this case, appears to be the swampy nature of the ground. We doubt whether the mobility of the floating station would prove advantageous, and the cost of the station cannot be ignored—old warships have a scrap value comparable with the cost of a new power station of moderate size. The idea might serve very well as an emergency measure—as, in fact, it did, during the war—but not, we think, as a permanent arrangement.—Eds. Elec. Rev.]

Radiators for Bathrooms.

With reference to "Radiator's" letter dated March 15th, which I saw on my return from abroad last week, an inspection of our glazed earthenware fires will convince "Radiator" that the heat control switches are adequately protected, inasmuch as they are sunk flush in the earthenware housing, the china switch handles being the only projection, and quite safe to operate with wet hands.

With regard to "Radiator's" suggestion that the elements should be protected so that drops of water cannot fall on the glowing wires, it would be difficult, and I might say impracticable, to make a completely effective water guard without obstructing the glowing effect of the fire; however, it is quite unnecessary in our fires, drops of water or even a fine stream of water would have little or no effect on the elements. It will be understood that the voltage differences between the turns is so small, about ¼-½ a volt, that there is no risk of short-circuiting, and the fact that the elements are wound on a fireclay insulating material base which in turn is mounted upon and within a glazed earthenware casing precludes the possibility of "earths."

If "Radiator" is interested in a watertight heater for bathrooms, then our electric hot-water radiators or rather convectors, towel rails, or gown airers meet the case. See enclosed pamphlets.

The General Electric Co., Ltd.
O. G. Nobbs,
Manager of Heating & Cooking Dept.

London, E.C.
April 9th, 1920.

Tumbler (?) Switches.

We have a distinct impression, although we cannot now trace the source, that the correct name for these switches is "Tumler," being the name of an individual who possibly was the inventor of the switch motion, in spite of the fact that the word "tumbler" seems to be almost invariably used.

If you can verify that this is the case, we should like to see this common error corrected in your columns.

E. Fowler Clark.

Messrs. Rolls-Royce, Ltd., Derby.
April 10th, 1920.

[Messrs. A. P. Lundberg & Sons inform us that the movement was invented by Mr. A. B. Blackburn, of the Edison Swan Co.; it is sometimes called "Tumler," but "Tumbler" is the correct form.—Eds. Elec. Rev.]

The Tucker Microphone.

In your issue of April 2nd an article by Mr. G. E. Moore makes a reference to my microphone. The suggestion is that the invention is not new, and reference is made to microphones of Dr. Eccles and Prof. McGregor Morris. The examination of patent 13,123/16 which has recently ceased to be a secret patent, will show that there is a fundamental difference between this microphone and others previously in use, and this difference formed the basis of the Royal Commission award of £4,000.

Unfortunately, I am prevented from publishing an account of its work, as the latter is still regarded as "secret." Although, therefore, there is every prospect of the hot-wire microphone developing as a scientific instrument of extended use, it will probably continue to be considered as an interesting "gadget" hurriedly improvised to cope with very exceptional war conditions.

W. S. Tucker.

Woolwich.
April 10th, 1920.

Wages in Kinemas and in the Electrical Industry.

I was interested to note Mr. Albert J. Cutler's remarks anent my letter of the 26th ult. under above heading. I think he has an idea that I have an animus against kinema operators. This is not so. *Skilled* operators are entitled to all they can get, and personally the writer is of opinion that, in view of the fact that they are mainly responsible for the successful running of kinema shows and that the "trade" is so ostentatiously wealthy, a wage of £10 per week should not be out of the question.

Mr. Cutler's assurance that the E.T.U. insists on five years' experience as a qualification is welcome. Apparently my information was incorrect. I find that a recent agreement in respect of the London area stipulates four years as the qualifying period for a chief operator.

Your correspondent admits that there are many "handle-turners" masquerading as kinema operators. These men (and boys) are a latent menace to *bona-fide* operators, and to the safety of kinema patrons. Yet, in spite of their existence, the number of outbreaks of fire per year is ridiculously small. Surely this disproves Mr. Cutler's assertion that we must admit the possibility of fire with "the best and coolest of men"?

Mr. Cutler is inclined to question my knowledge of the kinema machine, and he wonders whether I have experienced operating-box conditions. Some years ago I held a position as chief operator-electrician, and some of my practical notes were published at the time in a trade journal. I must again insist that the design of projection equipments is so efficient as practically to preclude any chance of fire. Small wonder, as I have pointed out before (and this is apart from the wages question), that projection work does not appeal to the average electrician.

G. E. Moore.

London, N.
April 12th, 1920.

Mr. F. E. Heal is requested to send us his address.—Eds Elec. Rev.

Engineering Labour.—The Labour Correspondent of the *Financial Times* writes as follows:—"The second ballot of the 46,172 members of the Amalgamated Toolmakers' Union has given the required majority for amalgamation with the Amalgamated Society of Engineers. Of the votes recorded 28,052 were in favour of amalgamation, and 2,309 against. The surprising feature of the ballot is that nearly 16,000 members, or practically one-third of the whole, had not sufficient interest in the matter to record their vote either for or against the proposal. The nine Unions forming the Engineering Unions' Amalgamation are the Amalgamated Society of Engineers, the Machine Workers, the Smiths and Strikers, the Steam Engine Makers, the Associated Brass Workers, the Scientific Instrument Makers, the North of England Brass Workers, the London Metal Workers and the Tool Makers. The National Brass and Metal Mechanics are also going to take a ballot as to joining forces with the Engineering Amalgamation. Altogether it will be an exceedingly powerful combination."

ELECTROLYTIC IRON.*

Despite the numerous experiments and researches made by various investigators extending over more than half a century, it is only within the last few years that the electrolytic manufacture of iron on a large scale has reached a commercially successful stage. The earlier attempts were purely of a technical nature, and mainly in the direction of the electrodeposition of iron for stereotypes from either ferrous sulphate or ferrous chloride solutions.

Seamless iron tubes, analogous to the copper cylinders manufactured by the Elmore process, were made by Cowper-Coles about 1908.

The electrolyte preferably used by Cowper-Coles, and considered to yield the best results, was a 20 per cent. solution of sulfo-cresilic acid saturated with iron.

In 1909, Franz Fischer, a Berlin chemist, succeeded in producing considerable quantities of electrolytic iron with highly concentrated solutions of iron chloride and calcium chloride, working at a temperature of 110° C., and with a current density of 20 amperes per square decimetre. The Langheim Pfanhauser Works at Leipzig attempted the direct industrial production of sheet-iron having a thickness of 5 mm. The purity of the metal reached 99·99 per cent.; it was easy to weld, suitable for autogenous welding, and melted at 1,600° C.

But the first patents for the electrolytic manufacture of iron on a really industrial and commercial scale were taken out in 1910 by the Société "Le Fer," of Grenoble. In principle, the method used depends upon the employment of a rotating cathode and a neutral solution of ferrous salts kept in the neutral state by the circulation of the liquid on iron filings. Regular additions of a depolarising agent, such as oxide of iron, are given to the bath to eliminate as far as possible the hydrogen formed on the cathode which, if present in large quantity, would be detrimental to the iron deposited.

Very high current densities can be worked with, about 1,000 amperes per sq. metre, and a metal of excellent quality is obtained which can be at once utilised industrially. This iron successfully competes with the fine irons, and the Swedish irons so well known for their purity. The Saint-Marie and Gravigny Foundry, and the works of Bouchayer & Viallet, also produce sheet-iron and tubes in a great variety of weights and shapes in the finished state directly by electrolysis.

For the commercial production of electrolytic iron practical experience has shown that heavy current densities must be employed for the best quality product and maximum output. In general the electrolyte consists of a solution of ferrous chloride or ferrous sulphate, or a mixture of the two salts. To obtain a smooth, dense, homogeneous deposit, and one which can be utilised after simple annealing, the electrolyte should be preliminarily treated, as otherwise the bath which is greenish in colour only gives a metallic deposit of very irregular form, and having no commercial value. The electrolyte is first agitated in a small cell by simply rotating the anode for example, so as to produce an oxidising action of the air at the same time as the electrolytic action. The salts of iron being very easily oxidisable in the air, a modification of the composition of the bath ensues; iron oxychloride is formed which reacts upon the hydrogen deposited on the cathode in the form of gas bubbles, which causes the bad quality of certain deposits. When the bath ceases to froth, and has a brown colour, it is in a satisfactory electrolytic condition, and can be utilised for an industrial run.

Unless the electrolytic solution is kept in a neutral condition it is found that the iron which is deposited scales, and cannot be utilised commercially. This neutral condition is attained by keeping finely-divided iron in suspension in the bath.

For the preparation of electrolytic iron for printing blocks and electro-plating, according to Muller, low voltages and low current densities should be used. He has used both the double sulphate of iron and ammonium, and the chloride of iron for the electrolytic solutions.

It appears that the higher the current density and the more concentrated the electrolyte, the denser and more homogeneous is the iron deposited.

In order to obtain the highest purity of iron, it is essential for the anodes themselves to be as pure as possible.

According to Burgess, with an electrolyte containing 40 gm. of iron as iron sulphate, and 40 gm. of ammonium chloride per litre, the electrolytic refining of iron can be conducted without interruption. With anodes of better quality commercial iron (pure iron), the electrolytic iron reaches 99·97 per cent.

It is estimated that 1 kw.-hour would be necessary to purify 1 kg. of iron, and would cost 0·05 fr. The cost of working (labour, maintenance of the electrolyte, general expenses, &c.), does not appear to be higher than the price of energy, in consequence the refining would work out at about 100 fr. per ton. With mild steel anodes at 175 fr. per ton, electrolytic iron would thus cost approximately 275 fr. per ton, and could compete with pure Swedish iron.

According to L. Guillet, the cost of raw electrolytic iron should not exceed 200 fr. to 220 fr. per ton.

Coarse electrolytic iron in the unfinished state contains a very small proportion of impurities, such as silicon, phosphorus, sulphur, manganese, and carbon. Most samples of electrolytic iron, as it comes from manufacture, also contain certain gases, carbon monoxide, carbon dioxide, nitrogen, and above all, hydrogen. The hydrogen can be eliminated by annealing. The appearance and the physical characteristics of the iron to a great extent depend upon the percentage of hydrogen it contains. Electrolytic iron containing hydrogen is also magnetic, and on being magnetised is much stronger than ordinary magnets.

Using a cast-iron containing 2·35 per cent. carbon, 1·31 per cent. silicon, 1·07 per cent. sulphur, and 1·07 per cent. phosphorus, the electrolytic iron prepared from it only showed 0·004 per cent. carbon, 0·007 per cent. silicon, 0·006 per cent. sulphur, and 0·008 per cent. phosphorus, which indicates the degree of refinement which can be attained.

The mechanical properties of electrolytic iron, such as tensile strength, bending, elongation, hardness, &c., vary according to the method of treatment. A tensile strength of 30·9 kg. to 32·8 kg. per sq. mm. was obtained with an elongation of 40·3 to 43·1 per cent. with electrolytic tubes annealed for two hours at 900° C. in magnesia. As regards hardness, the raw electrolytic iron as it comes from the bath is hard and brittle, and gives a Brinell test of 193 (diameter of ball 10 mm., pressure 3,000 kg.); reheated at 900° C., the hardness falls to 90.

The resistivity of electrolytic iron has been the subject of various researches. L. Guillet and Porterin give 9·98 microhms per cm. cube as the average of a number of measurements made on annealed rods 12 cm. long and 5·7 mm. in diameter, after allowing a correction of 0·24 microhm per cm. cube for the arsenic and phosphorus in the iron, although in minute quantities.

Similar experiments by L. Guillet and Porterin on unannealed bars 12 cm. long, and having a section of 5·1 mm. × 6·1 mm., gave 11·92 microhms per cm. cube corrected for arsenic and phosphorus.

As shown by the curves in figs. 1 and 2, electrolytic iron has low hysteresis and high permeability. Curve A is the hysteresis

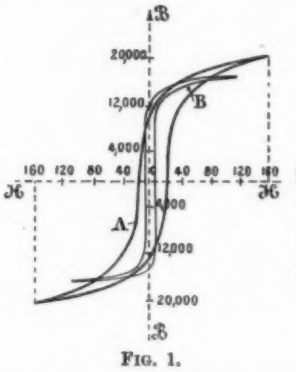


Fig. 1.

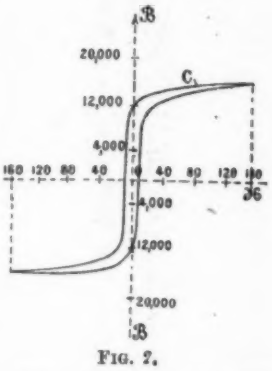


Fig. 2.

curve for the sample of electrolytic iron at ordinary temperature, and curve C is for ordinary iron. The coercive force of electrolytic iron is 20 gauss, and the remanent magnetism is about 10,800 gauss; for the ordinary iron the coercive force is 10 gauss, and the retentivity amounts to 12,000 gauss. The two samples were subjected to a temperature of 1,000° C., when curve B was obtained for the electrolytic iron sample. As the ordinary iron gave no sensible modification by the heat treatment, the corresponding curve is not shown for the sake of clearness. In the case of the electrolytic iron, the coercive force has fallen to 5 gauss, and the remanence has risen to 13,000 gauss. Under the action of heat, electrolytic iron thus approaches mild steel magnetically.

Electrolytic iron tubes are now being manufactured on a large scale, and at the works of Bouchayer & Viallet, they are being made up to 4 and 5 metres in length, 10 to 12 cm. in diameter, and from 0·1 to 6 mm. in thickness. The iron is deposited on a metal mandrel, the whole is then annealed, and immediately afterwards the tube is removed from the mandrel.

These tubes offer various advantages. It is well known that considerable difficulties are met with in the manufacture of iron tubes of uniform thickness below 6 mm., by the metallurgical processes in common use. In general, the thickness of the final product is very irregular, whereas by the electrolytic process it is uniform, whatever the diameter, thickness, and length of the tube. They are used for a number of purposes—for water pipes, steam mains, compressed air ducts, &c.—and their application has so far not given rise to adverse criticism.

Uniform iron plates are also obtained directly by electrolysis, *i.e.*, without rolling. The metal is of first-class quality, is easy to work, and can be subjected to severe strains in the cold state as in drawing plates of different sizes and thicknesses. Owing to the magnetic properties of electrolytic iron it offers advantages in the construction of transformers, dynamos, and motors. By using sheets of electrolytic iron, the weight efficiency of transformers can be increased by about 35 to 45 per cent.; in the case of alternating-current motors for the same temperature and space occupied, the capacity can be increased about 50 per cent.; and with direct-current motors and dynamos, an economy of about 16 per cent. can be effected in the weight of iron used.

As regards the use of electrolytic iron for transformer plates, it is well known that the losses tend to increase with the time of service of the transformer, and the deterioration of these plates takes place more rapidly as the temperature increases. Electrolytic iron, however, gives a good guarantee against ageing, as its crystalline structure is very stable. The same applies to ferro-silicon.

* Abstracted from a series of articles by Jean Escard, in *Le Génie Civil*, Vol. LXXV, Nos. 8, 9 and 10.

REMINISCENCES OF A SUBMARINE CABLE PIONEER.

By ROLLO APPLEYARD.

In looking through some old papers, I recently came upon the following letter; it was written to me in 1909 by the late David Jenkins. Throughout his life he had been closely associated with the manufacture of submarine cables, and towards the end of his career nothing pleased him more than to recount the story of the early progress of his distinguished shop-mate, Willoughby Smith. As it is doubtful whether there is associated with the development of telegraphy and the cable a more noteworthy example of success won against adversity by hard and intelligent work than that afforded by Willoughby Smith, some of your readers may—after this lapse of beneficent time—care to read this letter. The history of the submarine cable itself has been admirably told by writers, from W. H. Russell to Charles Bright, but this brief note by David Jenkins adds something to the human side of the romance, and indicates how it struck a contemporary.

In the year 1851 I went to work for the Gutta Percha Co. in Wharf Road, City Road. They were making the core for the cable to connect Dover and Calais, and a very successful cable it was, the copper wire .064, covered with two coats of gutta percha to .300; coal tar naphtha was used between the coats to cause the coats to unite. The coils were sent to Wapping, where the cable was made and shipped. It was the first successful submarine cable that was made. Mr. Willoughby Smith was there working as examiner and jointer; he became one of the first electricians of the day. The manager of the works, Mr. Samuel Staton, offered a reward of £2 to the man that could make the best joint. Every man that wished could compete—the electrician was to be the judge. Mr. Willoughby Smith's joint was the best—a great many men competed. In the year 1854 there was war with Russia. The Russians sank a lot of ships before the harbour of Sebastopol to prevent the Allied Fleet from entering. Those ships the English Government wished to blow up. Accordingly divers and electricians were sent to do this. Mr. Willoughby Smith and Mr. Orchard were appointed. Mr. Smith did not like the job, but there was a young assistant electrician who wished that he had been appointed to go. I knew this young man by name as Mr. Henry. Mr. Smith and Mr. Henry approached the manager to allow them to change places, which was granted. Mr. Henry and Mr. Orchard went sometime in October in a ship called the "Prince." They arrived in due time in Balaclava Harbour. On November 5th a tremendous storm arose and wrecked 28 transport ships, among them the "Prince." Mr. Henry, Mr. Orchard, and the crew were drowned.*

Mr. Smith had gone a dozen steps up the ladder of prosperity. The G.P. Co. made a great many cables. Many were a success and many a failure. I think it was in 1856 they made the first Atlantic cable, the copper wire of .029 covered with three coats of gutta percha to ⅜ in. The cable was made partly at Greenwich by Glass & Elliott's, and partly at Birkenhead by Mr. Newall, and this was shipped in the "Niagara," the Greenwich part in the "Agamemnon." The two ships met in mid-Atlantic; the "Niagara" was to lay her cable to Newfoundland and the "Agamemnon" to Queenstown, in Ireland. They made two unsuccessful attempts; the third they laid the cable, and said that they got a message through, and then they could not get any more, so the whole thing was a complete failure. The G.P. Co. made a great many cables for land purposes, and gutta percha goods, and general work. In the year 1861 there was a slackness of work. I was stood off. I then went to work for Mr. Hancock at West Street, Smithfield, the next week—I think that would be in June. Mr. Charles Hancock was one of the first to bring gutta percha into use; his works was at Abbey Lane, West Ham. Not having enough capital to carry it on he took three gentlemen as partners—their names were Mr. Bubery, Mr. Gurney, and Bunson; this was sometime in 1846 or 1848, I cannot say the exact time. As time went on, trade increased, and they took another larger place in Wharf Road, City Road. They made all sorts of G.P. articles, and patented a great many. One of the chief patents was copper wire insulated with gutta percha. This patent Mr. C. Hancock claimed as his own, and Mr. C. Hancock disagreed with the other gentlemen of the company. They would not admit him in the works at Wharf Road. They instructed the gatekeeper not to admit him, and if he insisted, to put him out by main force. This the gatekeeper did, and in doing so he tore Mr. Hancock's coat. Mr. Hancock summoned the gatekeeper for assault, and I think they had to pay a small fine; this was the commencement of trouble between Mr. Hancock and the other partners of the company which lasted four years. I think the greatest battle was over the patent of insulating copper wire with gutta percha; in the end it was settled that both parties had a right to use it. The Wharf Road and West Ham were two separate firms ever after. The West Ham, owned by Mr. C. Hancock, was managed by Mr. Branscon, a very shrewd business man. Under Mr. Branscon the firm prospered. About the year 1855 Mr. Hancock left West Ham and leased a large premises at West Street, Smithfield, and there was some disagreement, and Mr. Branscon left. This was a bad job for Mr. Hancock, as the Wharf Road people took Mr. Branscon in at once. The premises that Mr. Hancock leased belonged to Galloways, boiler makers, who had removed to some place near Manchester. Galloways occupied about three acres of land in the city, which the Corporation wanted for street and meat market improvements; the Corporation bought Mr. Hancock out; this was some time in 1864. Mr. Hancock then amalgamated with the I.R.G.P. Co., of Silvertown. The company engaged Mr. Walter Hancock, who was a civil engineer, as manager of the gutta percha department. He was a smart man, and he laid the plans of the buildings and machinery, and completed the whole of the work in about two years, including the removal of the whole stock and machinery from West Street, to Silvertown. The engines stopped on or about December 7th, 1865. The new engines started at Silvertown on January 21st 1866. I was then transferred to Silvertown, January 1st, 1866. Some of the hands would not come to Silvertown, it being very unhealthy; it was badly drained; the people suffered from ague very much. The sanitary arrangements are much improved, the river bank has been raised to prevent overflow of the Thames at high tide. As for Silvertown, the inhabitants have increased I should say twenty fold. Silvertown in 1866 was quite country; they only had one policeman for Silvertown and North Woolwich. If you required his services, you had to go to North Woolwich to a small private house. He had a board over the door marked "police." Silvertown has improved of late, and there is still room for improvement. When Mr. Matthew Gray became manager of the I.R.G.P. works Mr. Gray and Mr. Hancock did not agree. Mr. Hancock resigned, and Mr. Gray engaged a clever mechanic from Wharf Road to fill up the vacancy—Mr. Gibson by name. He stayed about seven years, then he died. Mr. Ridley followed after Mr. Gibson. I may say that when Mr. Gray made his first submarine cable and shipped it on board the s.s. "Narver," Mr. Chatterton stopped the ship under the pretence the company had infringed his patent for the compound. That, of course, delayed the job for some time. The compound was patented by Mr. Chatterton, but it was the idea of Samuel Smith that worked at Wharf Road when I did. Samuel Smith asked Mr. Chatterton to remunerate him for the idea, but he would not. Smith lost his temper and called Mr. Chatterton a b—— rogue. Chatterton gave him the sack for his pains.

D. Jenkins.

23, Winchester Street, Silvertown.

* The "Prince" was caught in the hurricane of November 14th, 1854, *vide* "The British Expedition to the Crimea." W. H. Russell, p. 180.

Intercrystalline Brittleness of Copper.—When copper is heated in a molten bath of sodium chloride for the purpose of cleaning and softening, it has been noticed that the copper is embrittled. Under these conditions the copper is more or less in contact with iron or steel, either from a stirring rod, forceps for handling the piece, or the pot used to contain the salt, and a "galvanic couple" with the copper as cathode would be formed. According to the *Journal* of the Franklin Institute, experiments were made at the U.S. Bureau of Standards with small rods of copper and mild steel which were made either anode or cathode in a bath of molten salt and with an E.M.F. of approximately six volts. The brittleness of the copper rods was compared with untreated material by bending the specimens back and forth with one end firmly clamped. The copper rod which was an anode was as tough and soft as the original, and required practically the same number of bends to cause it to fracture. The cathode copper was found to be very brittle. Microscopic examination showed the anode copper to be perceptibly smoother on the surface than the original material; the structure was that of annealed copper. In the cathode copper rod the crystalline boundaries on the surface are well defined, and the intercrystalline boundaries for an appreciable depth within the metal are made wider. The probable explanation of embrittlement of the copper when it is made the cathode is that an appreciable amount of metallic sodium is formed by the electrolysis, which immediately alloys with the copper, the attack being selective towards the grain boundaries rather than forming an alloy layer of uniform thickness upon the outside.

Finsbury Technical College.—The Old Students' Association magazine, which ceased publication during the war, has reappeared. The chief aim of the present number is to organise the Association on new lines, and members are asked to vote for or against the adoption of new rules. A meeting to discuss this subject is being held at the College on May 4th, at 6.15 p.m. The annual conversazione is to be held at the College on the evening of April 30th; tickets, at 2s. each, are obtainable from the Conversazione Secretary, at the College. Old students can obtain a copy of the magazine by applying to the Hon. Sec., Old Students' Association, Finsbury Technical College, Leonard Street City Road, E.C.

BUSINESS NOTES.

Italian Companies.—The Italian Edison Co., of Milan, which has a share capital of 96,000,000 lire, reports net profits of 9,782,000 lire for 1919, and a dividend of 34 lire per share of 300 lire. The Tecnomasio Italiano Brown-Boveri, of Milan, records net profits of 994,000 lire on a share capital of 12,000,000 lire, and a dividend at the rate of 8 lire per share.

Dissolutions and Liquidations.—Speen Mechanical Repair Depôt, mechanical and electrical engineers, 283, Poulton Road, Seacombe.—Messrs. C. J. Savery and C. W. J. Bartlett have dissolved partnership. Debts will be attended to by Mr. C. J. Savery, who will continue the business.

E. & C. Gates, electrical engineers and advertising sign manufacturers, 56, London Street, Norwich.—Messrs. C. and E. C. Gates have dissolved partnership. Mr. C. Gates will attend to debts and continue the business under the same style.

Messrs. H. Slead and P. F. Senior, trading as Slead and Senior, electrical engineers, 103, King Cross, and 48, Peelon Lane, Halifax, have dissolved partnership. Mr. P. S. Senior will continue the business under the same style.

Sissons Bros. & Co., Ltd., Hull.—Meeting of creditors under the voluntary liquidation, April 16th.

Newall's Insulation Co., Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. F. S. Newall. A meeting of creditors was called for April 14th.

Wilson & Newton, wholesale stationers and dealers in electrical accessories, 65, Market Street, Manchester.—Messrs. A. E. Wilson and J. Newton have dissolved partnership. Mr. A. E. Wilson will attend to debts and continue the business under the same title.

Catalogues and Lists.—Messrs. Metrodes, Ltd., 87, Fargate, Leeds.—Circular giving prices of "Metrodes"—metal electrodes for use in electric welding.

The Enterprise Manufacturing Co., Ltd., Gun Street Electrical Works, Bishopsgate, E. 1.—Postcard illustrating the "Smoovit" electric iron. Priced.

Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, E.C. 4.—Catalogues No. 1014 (16 pp.) and 1052 (20 pp.). The first is an illustrated list of "Monogram" fans for various applications; it also includes hand-driven fans and accessories. No. 1052 deals with Sturtevant steel plate fans.

Messrs. Siemens Bros. & Co., Ltd., Palace Place Mansions, Kensington Court, W. 8.—Pamphlet A-710 (12 pp.). An illustrated list of loud-speaking telephones and accessories, including switchboards and boxes.

The Wilson-Wolf Engineering Co., Ltd., Bradford.—Card advertising "Wilson-Wolf" 1920 pattern ball-bearing motors—fractional horse-power sizes.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C. 2.—"The Essential Factor," "Le Facteur Essential," and "El Factor Esencial" (16 pp.). An interesting introduction in English, French, and Spanish to the company's general catalogue.

The Swift Electrical, Ltd., 25, Castle Street, Falcon Square, E.C. 1.—Booklet illustrating and describing the "Lotoc" electric bell, for which this company is the sole London agent.

The "Z" Electric Lamp Manufacturing Co., Ltd., Standen Road, Southfields, S.W. 18.—Leaflet giving an illustration and details of the "Z" electric vacuum cleaner.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Two illustrated pamphlets dealing respectively with electric hot-water radiators and electrical bath-room equipment.

The State of German Industry.—The Department of Overseas Trade is informed that many orders which were given at the Frankfort Fair held in October last, and also at the Leipzig Autumn Fair, are still unfulfilled, and there is no prospect of their being carried out at anything like the agreed-upon prices, nor can any satisfaction be obtained from the respective German manufacturers. German industry is absolutely distrusted at the present time, owing to (1) the difficulties in connection with obtaining raw materials, shortage of coal and the upward trend of production costs, and (2) the very questionable tactics which German manufacturers are showing to foreign buyers, particularly as regards the system of accepting contracts with the proviso "freibleibend," that is, that the terms are not binding.

Some 800 prospective buyers from Denmark attended the Leipzig Fair, but no contracts appear to have been made, although it is stated that the intention of these buyers was to purchase goods to the extent of 1 milliard kronen. The outlook had, however, frightened off all prospective purchasers.

Stolen Motors.—Charles Baden Powell, Arthur Reginald Mason, and Harold Frederick Harding, all of the Royal Air Force, appeared at Edinburgh Sheriff Court in connection with thefts from Turnhouse Aerodrome. They all pleaded guilty to stealing three motor engines, and Powell and Mason admitted stealing a quantity of tools and seven driving belts. An agent explained that there was a civilian caretaker in charge, and he believed there had been laxity in supervision, which had tempted the men to carry out the thefts. All accused bore a good army record. The Procurator Fiscal said the engines were worth £400, and the tools and driving belts about £60. Accused had sold the engines for £32, and the other material for £12. Sheriff Crele sentenced Powell and Mason to three months' imprisonment each, and Harding was sent to prison for two months.

Plant for Sale.—The City of London Mental Hospital, Dartford, has for disposal one 4-cylinder, 105-B.H.P. Thornycroft Diesel engine, direct-coupled to 75-KW. Lancashire Dynamo Co.'s generator, &c.

Whitby Urban Council has for sale one 100-KW. Parsons turbo-generator and one 28-H.P. vertical enclosed steam engine. See our advertisement pages to-day.

Trade Announcements.—Messrs. Schneider & Cie., of Paris, have removed their London address to 30, Victoria Street, S.W. 1 (Phone: Victoria 2919), which is also the address of their representatives for Great Britain and Colonies—Messrs. J. & P. Hill.

Mr. B. L. Myer who, as announced here, recently dissolved partnership, is now carrying on business as the Electric and Engineering Specialties Co., at 79, Great George Street, Liverpool. He holds the sole agency for Liverpool and Manchester district for several electrical firms, and he wishes to receive manufacturers' catalogues and terms.

Messrs. Rejax, Ltd., of 3 and 4, Percy Street, Tottenham Court Road, W. 1, are now making agency arrangements for all parts of the Kingdom for their "Rejax" lighting and power plants, which are being put in by numerous small hotel proprietors, householders, farmers, &c. Copies of their publicity literature will be sent on application.

Messrs. Goodenough & Co., electrical engineers, of Barnstaple, have removed from Rackfield, to larger premises at Trinity Works, Barbican.

The businesses of Messrs. C. & T. Cannon, of Burton and Aylesbury, and Messrs. W. Y. Green & Co., of 14 and 16, Walton Street, Aylesbury, have been amalgamated, and will be carried on under the style of Cannon, Green & Co., heating and lighting engineers.

Site for Works.—Particulars of a building site of about 9 acres, at Barrow-in-Furness, are given in our advertisement pages to-day.

New French Companies.—Among the new companies recently formed in France are the Société Le Moteur Electrique, of 18, Route de Cremieu, Villeurbanne, capital 1,000,000 fr.; and the Société Electrique de la Siderurgie Lorraine, 63, Avenue Victor-Emmanuel, Paris, capital 8,000,000 fr.

Agencies in Holland.—H.M. Commercial Secretary at The Hague, in a recent report, says:—"Many British firms with business relations of old standing with Holland are not represented here, but content themselves with sending a representative once or twice a year to book orders. The best comment on this is a reply actually given by a local firm to one of these travellers who was making his half-yearly round to book orders:—"Sir, the chances against my wanting something on the day of your visit are something like 180 to 1." Representation can be summarised in the following scale, arranged in order of merit:—

1. Branch office in Holland with or without stocks, according to circumstances.
2. Resident British representative.
3. Agency entrusted to British merchant firm established in Holland.
4. Agency entrusted to Dutch firm.
5. No local representation; traveller making periodical visits.

Numbers one and two are, of course, beyond the means of many firms, but the suggestion has been made that several manufacturers of cognate but non-competing articles might establish a selling agency in common on one or other of these bases.

It is considered above all important that no British firm should appoint a local agent without first sending a responsible member of the firm to examine local conditions, ascertain the type of article most in use, and make careful inquiries as to the capacity of the agent to cover the district entrusted to him and as to other and possibly competing agencies held.

The question of advertisement in Holland is one which would repay further study by experts, as the conditions, both material and psychological, are very different to those obtaining in the United Kingdom, and the opportunities are large, the art of advertisement here not having by any means reached the standard of Great Britain and America.

A Danish Cable Firm.—The report of the directors of the Dansk Kabelfabrik states that the company's efforts were directed in 1919 towards getting the factory in satisfactory operation. The difficulties in the way of the delivery of machinery and raw materials, which were chiefly purchased in America and England, were considerable; transport problems in connection with harbour strikes and lack of space at Copenhagen harbour delayed the arrival of the machinery for some months, as the latter was discharged in various ports abroad and in Denmark, and had then to be forwarded on to Copenhagen. Moreover, many of the machines arrived in an incomplete condition, and it was therefore necessary partly for the company to finish them and partly to procure some parts from foreign firms before the machines could be brought into use. Under these circumstances, it was only possible to begin rational working in the autumn, and get the production in proper progress. At the same time, the directors were successful in finding a technical director in Mr. T. C. Thomsen. It was expected that manufacturing would be considerably extended in the next few months, and the factory show remunerative activity.

Catalogues Wanted.—Messrs. James Ord & Co., 38, Tyne Chambers, Newcastle-on-Tyne, wish to receive catalogues and other publicity matter from electrical manufacturers and dealers.

The Arc Electrical Co., Trevelyan Buildings, Corporation Street, Manchester, want manufacturers' catalogues and lists.

Railway Wagon Detention: Improvement. — The Ministry of Transport states that very gratifying results have followed the increase of the demurrage charges on railway companies' trucks which became operative on January 1st. The figures for February, which are now available, show that wagon detention has decreased by 42 per cent., as compared with December, representing a saving of over 150,000 wagon days.

The Holland Wire and Cable Works.—The report for 1919 of the directors of the N.V. Hollandsche Draad en Kabelfabriek, of Amsterdam, first recalls the fact that 10 years have now elapsed since the undertaking was established, and figures are given showing the course of the development during this period. The report proceeds to state that it was considered desirable to bring the social capital more into agreement with the actual capital by capitalising the undisclosed reserves formed in the course of years. As a consequence, the balance of the working account contained not only the results for the financial year 1919, but also the reserves in question, and the directors proposed to distribute a dividend of 50 per cent. in shares, and the remainder (18 per cent.) in cash. The results obtained in 1919 were favourable. This was due to a large extent to the fact that the company succeeded in the early months of the year in getting transported to Amsterdam the large stocks which had been awaiting shipment for some years, so that they no longer had to contend, as in previous years, with inadequate supplies of raw materials; and the export trade which thereby again became possible, yielded very favourable results. There was nothing unfavourable to set against these favourable factors, thanks to the maintenance of the principle during the war of keeping stocks on the level of peace time prices, and as a consequence the inevitable losses on war-time raw materials, in so far as they were still in stock on the termination of war conditions, were already written off beforehand. Concerning the future prospects, the report states that the company were favourably circumstanced as their principal raw materials—copper, rubber, and cotton—were all derived from countries possessing a sound currency. Thus, the influence of the low level of exchange in the case of other industrial countries was limited chiefly to wages and general expenses, which factors were of considerably less influence with the articles manufactured by the company. On the other hand, the company were placed at an advantage in the financing of raw materials precisely through the Dutch rate of exchange. After making provision for depreciation, the accounts show net profits of 2,090,282 florins, permitting of the payment of the dividends (68 per cent.) already mentioned. The balance-sheet contains, for the first time, an entry entitled "personnel obligations," amounting to 11,850 florins. It is explained that this is in accordance with an arrangement under which the staff is permitted to take up a financial interest in the company by means of profit-sharing obligations. The comparative statement showing the progress of the company indicates that the paid-up capital has increased from 120,000 florins in 1910, to 1,809,000 florins in 1919; and the dividends from 10 per cent. in 1912, to 12 per cent. in 1914, 15 per cent. in 1915, 16 per cent. in 1916, 17 per cent. in 1917, 18 per cent. in 1918, and 68 per cent. in 1919.

Auction Sales.—Assets Auctions Co., Ltd., will sell by auction, at 119, Newington Causeway, S.E., on April 21st, the stock of an electrical goods factor. On April 27th to 30th, Messrs. Buckell & Ballard will offer for sale by auction, buildings, fittings, and electrical plant, at an Oxfordshire aerodrome. For full particulars see our advertisement pages to-day.

Book Notices.—*The Engineer's Year-Book for* 1920. Edited by H. R. Kempe, M.Inst.C.E., and W. H. Smith. Pp. 2581; figs. 2250. London: Crosby Lockwood & Son. Price 30s. net.—This is the twenty-seventh year of publication of a volume which may be justly described as an old friend; though long past its majority, it still keeps on growing, having now exceeded a total of 2500 pages, and the reference in the preface to the "growth in the literature" of industrialism is obviously appropriate. In the present issue, besides the revision or rewriting of many of the existing sections, we find a number of entirely new sections—the metering of water, air, gas, and steam, windmills, electric welding, acetylene, oxy-acetylene welding and cutting, &c.—while the matter has been in many respects rearranged and improved. Much attention is given to costs, and a useful buyers' guide is provided. By no means least of the valuable features of the work is the exhaustive index, and the system of cross references in the text, which enables the user to find with ease passages which bear upon the subject of research. The *Year-Book* contains an extraordinary quantity and variety of information, and that its value is appreciated by the engineering public is testified by its vigorous growth and mature years.

Willing's Press Guide, 1920. London: James Willing, Ltd. 2s.—This book continues to live up to its established reputation as a concise and comprehensive index to the Press of the United Kingdom.

Half-Past Twelve—Dinner-Hour Studies for the Odd Half Hours. By George W. Gough. London: Sells, Ltd. 1s.—This is a pamphlet consisting of 26 brief chapters, which are studies in simple economics. The author begins by asking: "What is Political Economy?" and he considers later, in simple and interesting language and style, such subjects as the production of goods, the division of labour, capital—what it is and what it does—industrial organisation, the wages of labour, wages in relation to output, the profits of the "boss," competition and combination, exchange questions, the principles of taxation, &c. We commend the studies to the attention of our readers, to whatever class of society they belong.

"Currency Reform and the Need for a Nickel Coinage on a Decimal Basis." By G. E. M. Johnson. Pp. 18. London: The Decimal Association.—"The working man will never agree to the tenpenny shilling" is the final word of the opponents of national progress in the shape of a reorganisation of our present involved currency. Major Johnson proves the "tenpenny shilling" a myth by explaining the system advocated by the Decimal Association. The adoption of the "pound-mil" scheme would mean that the present shilling would be actually worth 50 mils, or with a nickel coin of two mils face value (practically a halfpenny) the same value as at present. The prestige of the British sovereign, and its concomitant advantages, would in no way be damaged by the adoption of the "pound-mil" system, and thus another contention of the decimal system's opponents is refuted. The author deals with historical facts concerning decimal coinage, and compares the various systems suggested and in use in other countries. He also gives a table of the proposed components of the system, which means the introduction of two nickel coins of five and ten mils face value. The present bronze coins would be retained (for a time, presumably), their value being slightly depreciated.

"The Indicator Handbook." By Charles N. Pickworth, Wh.Sc. Pp. 134; figs. 156. London and Manchester: Emmott & Co. Price 7s. 6d. net.—This is a reprint in which the former two volumes are combined. The work, which has become a classic, is too well known to need any comment.

"Les Fiches Industrielles" is the name of a new publication giving abstracts of articles in technical journals of all kinds, classified in series so that the purchaser can choose the series most directly relating to his own business. The annual subscription for each series, outside France, is 34 fr., except in the cases of Series IV (metallurgy, mechanics, electricity) and Series V (chemical industries), for which it is 46 fr. It is published at 51, Rue de l'Hotel-de-Ville, Lyons, France, by the Société d'Editions Commerciales et de Publicité Moderne.

"Post Office Electrical Engineers' *Journal*." Vol. XIII. Part 1. April, 1920. London: The Electrical Review, Ltd. Price 2s. net.

"Whittaker's Electrical Engineer's Pocket-Book. Edited by R. E. Neale, B.Sc. Fourth Edition. London: Sir I. Pitman & Sons. Price 10s. 6d. net.

"The M. & C. Apprentices' Magazine." Vol. IV. No. 13 (65 pp.). Price 3d. The present number, like its predecessors, is full of interesting matter, and includes articles on "Darkest Russia," and Milan, as well as a record of the firm's social events.

"Notes on Gas and Oil Engine Accidents" (32 pp.). Manchester: The National Boiler and General Insurance Co., Ltd. Price 1s. net.—This publication deals minutely with such causes of accidents as broken crankshafts, failure of connecting-rod bolts, &c., with suggestions for their prevention.

"Vickers News." No. 13, Vol. 2 (20 pp.). London: Vickers, Ltd. The present (April) issue possesses many interesting features, including a description of some large horizontal gas engines constructed by the company, and notes by Dr. Chalmers Mitchell on the ill-fated flight from London to the Cape of Good Hope.

"Continuous-Current Machines." By S. P. Smith. London: Benn Bros., Ltd. Price 5s. net.

"The Use of Low-grade and Waste Fuels for Power Generation." By J. B. C. Kershaw. London: Constable & Co. Price 17s. net.

"I.E.C. Rules for Electrical Machinery." Vol. I. London: The International Electrotechnical Commission. Price 2s. 2d., post free.

"The Engineering Foundation: A Progress Report to United Engineering Society" (32 pp.). New York: Engineering Societies' Building.—A report upon the foundation administering the joint interests of the four leading American engineering societies, the objects of which are set forth, including the assistance of national research.

Australian Engineering Developments. — A Press dispatch from Melbourne, dated April 11th, states that four representatives of Vickers, Ltd., are inspecting the engineering works of the Commonwealth with a view to estimating the possibilities of an extension of the firm to Australia.

Social.— The staff of the Lea Recorder Co., Ltd., held their first annual dance and social at Smallman's Café, High Street, Manchester, on Saturday, 10th inst. The directors and other guests were invited, and a thoroughly enjoyable evening was spent. The programme included a dance and whist drive, the prizes for which were presented by Mrs. J. E. Lea.

Board of Trade.—Sir Robert Horne, President of the Board of Trade, has constituted his private office at the Board as follows:—Principal Private Secretary, Mr. Cecil Litchfield; Second Private Secretary, Mr. C. Patrick Duff; Third Private Secretary, Mr. E. W. Reardon; Parliamentary Private Secretary (unpaid), Mr. F. C. Thomson, M.P.

Fuel Research.—The Secretary of the Department of Scientific and Industrial Research announces that a licence has been issued by the Board of Trade to the Scottish Shale Oil Scientific and Industrial Research Association. The Association may be addressed through Mr. W. Fraser, C.B.E., Scottish Oils, Ltd., 135, Buchanan Street, Glasgow.

Copper and Lead Prices.—Messrs. F. Smith & Co. and Messrs. James & Shakespeare report, April 14th:—No change in copper quotations. Messrs. James & Shakespeare report, April 14th:—English pig lead, £42 10s., a reduction of 10s. on last week's prices.

LIGHTING AND POWER NOTES.

Australia.—Tasmanian Hydro-Electric Scheme.—In order to meet the extensive commitments for power in March, 1921, principally for supplying the Electrolytic Zinc Co.'s big industrial enterprise at Risdon, work is in progress on every stage of the Government's scheme for increasing the power supply at the Great Lake, which is to be developed to a capacity of 70,000 H.P., at a total estimated cost of £2,500,000.

About 300 men are at work constructing a canal whereby to divert the River Ouse into the Great Lake, and arrangements are in train for installing a considerable amount of additional machinery. Preliminary work in connection with the raising of the dam wall at the Great Lake is well under way, but owing to the impossibility of getting cement, it seems unlikely that concreting can be started this season. The widening of the existing canal and the preparations for the new pipe lines are under way. Good progress is being made with the preparations for the extension of the power station.

Preliminary work in connection with the harnessing of Lake Rolleston, on the west coast of Tasmania, chiefly for supplying the Mt. Read-Rosebery Co. with power for the production of 50 tons of zinc per day from the Read-Rosebery ores, is well advanced, and as soon as the power contract between the company and the Government has been ratified, active operations for the construction of the scheme can be commenced.—*Times.*

Bolton.—Breakdown of Plant.—Owing to a mishap at the Back-o'-th'-Bank works on April 7th, the second recent failure, 75 per cent. of the plant was put out of action. Several mills were compelled to close down temporarily in consequence, and the tramway services were curtailed.

Cotton Mills.—Work has just commenced upon what is to be largest block of cotton spinning mills in the world. The works will be driven throughout by electrical power from the Corporation power station.

Bridlington.—Price Increase.—The Town Council has decided to increase the charge for electricity for power by 8½ per cent.; this brings the minimum charge to 2d. per unit. Cables are to be extended to supply works and other premises at a cost of £1,300.

Bristol.—Opposition Withdrawn. — The opposition threatened by Bath City Council to the Corporation Electricity Bill, over the supply of Newton St. Loe, has been withdrawn as the result of the latest negotiations.—*Western Daily Press.*

Canada.—Electricity Shortage.—Commenting upon the recent decision of the Toronto and Niagara Power Co. to increase its charges for electricity by amounts varying in value to 40 per cent., the *Electrical News*, of Toronto, states that the policy of the Hydro-Electric Power Commission was to keep prices as low as possible in order to attract customers. This policy has created a demand which the Commission cannot at present meet. Competing organisations are, therefore, able to raise their charges, which is detrimental to the general industrial condition.

Canterbury.—Cable Extension.—The Town Council has applied for a loan of £2,500 for a new feeder cable.

Coxhoe.—Street Lighting.—Messrs. Bell Bros., Ltd., colliery proprietors, have submitted their terms for supplying electricity for public lighting. The draft agreement stipulates that for a term of seven years the company will maintain 50-C.P. lamps at an annual charge of £5 each, and 32-C.P. lamps for £4 10s., from September 1st to April 30th each year. All installations will be carried out by the company.

Dartford.—Sliding Scale.—The Urban District Council has decided to increase the charge for power by '05d. per unit in respect of every 1s. per ton advance in the cost of fuel above 36s. per ton, from May 1st next.

Derby.—Electricity Scheme.—It was announced at a recent meeting of the Town Council, that the scheme for the supply of electricity in the East Midlands has been revised. The Derby station, which since its inception had repaid £200,000 of the money spent upon it, was to be retained. The expenditure upon the new scheme would be distributed, as follows:—Derby, £120,000; Loughboro', £130,000; and Leicester and Nottingham, £600,000 each.

Electricity Supply Act.—Amendments.—On April 13th Sir Eric Geddes presented a Bill for the amendment of the Electricity (Supply) Act, 1919, to the House of Commons.

Ellesmere Port.—Extension of Time-Limit.—The Ministry of Transport has granted the Urban District Council an extension of time until the end of the year for carrying out the Electric Lighting Order of 1913, with an intimation that unless some definite steps have been taken before that date to establish an effective distribution system, any further extension may not be favourably considered. The Council is advised to consider a bulk supply, as the provision of a generating station will not be allowed. The Council has adopted this course, and is taking steps in the matter.

Hove.—Electricity Supply.—The terms upon which the Brighton Corporation will give a bulk supply are considered excessive, and further representations are to be made to the Electricity Commissioners upon the question of additional plant. The Commissioners have intimated that the Town Council will have to prove that the installation of new plant at the works will be more economical than a bulk supply. The estimated cost of the necessary plant and works for the supply is £18,000.

Larne (Co. Antrim).—Power Station.—The Council has passed the plans for the erection of a generating station submitted by the Electric Power and Lighting Co. Larne is the point of departure of the Stranraer-London mail.

Leeds.—Breakdown.—Through a short circuit at one of the sub-stations of the Corporation electricity department, several works in the district were deprived of power for over an hour. The tramways having an independent supply were not affected.

Macroom (Co. Cork).—Stoppage of Works.—It has been found impossible to keep the electricity works running, owing to inadequate coal supplies, and the town is therefore without electric light.

Manchester.—Rate Aid.—The Electricity Committee reports that, having regard to its commitments under the scheme for the provision of a new generating station at Barton, it is of opinion that there should be no "rate aid" contribution from the Electricity Department until that scheme becomes revenue earning.

Paisley.—Extensions.—The Blackhall electricity works is being extended, and a new sub-station to supply industrial works and tramways is to be erected at West Croft.

Rochdale.—Increased Bulk Supply.—Owing to increasing demands for electricity, the Corporation is considering the advisability of taking a further bulk supply from the Lancashire Electric Power Co.

Rotherham.—Linking-up Scheme.—The Town Clerk submitted letters received from the electrical adviser to the Ministry of Munitions with regard to the proposed linking-up agreement for the supply of electrical energy from the Rotherham and Sheffield power stations, and stated that Sheffield had intimated to the Ministry of Munitions that power would be required from Rotherham as soon as the works for linking-up could be completed, and had inquired whether the Treasury would contribute one-third of the cost of the necessary works. The Town Clerk stated that he had been notified by the electrical adviser to the Ministry of Munitions that if Rotherham would waive any possible claims it might have against the Ministry under existing agreements, the application made by the Sheffield Corporation would again be submitted to the Treasury. The Town Clerk reported that he had intimated in reply that he did not consider the Rotherham Corporation would be prepared to waive any of its claims under existing agreements.

St. Helens.—Extensions.—The Electricity Committee has decided to grant several applications for power, and, to meet increased demands, to install an additional E.H.T. cable to the Burtonhead Road sub-station, and to provide a switchgear cubicle and controller panel for the power station, at an estimated cost of £5,430; also an additional E.H.T. feeder to the Sherdley Road sub-station, at a cost of £3,180; one additional E.H.T. feeder to Sutton Road sub-station, at a cost of £1,430, and additional transformers and switchgear at Victors, Ltd., sub-station, at £3,265.

On the recommendation of the electrical engineer, in view of the increased load in the Pocket Nook area, the Committee has also resolved to erect a new rotary sub-station near the L. & N.W. Railway Station, at a cost of £12,000.

Southampton.—Strike.—In consequence of the decision of the recently-promoted superintendent to resign his membership of the E.T.U. and join the E.P.E.A., the employés at the electricity works ceased work on April 13th. The shipyards and many factories had to be closed, and the tramway services were suspended. The chief engineer and a small voluntary staff maintained a supply sufficient for street and hospital lighting.

Ulverston.—Electricity Supply.—The District Council has passed a resolution advocating the institution of an adequate supply of electricity for the Furness and South Cumberland area, extending from the River Usk, in Cumberland, to the whole of the area of Ulverston. It was stated that the project was necessary for the future development and general welfare of the district.

United States.—Inadequate Water Power.—The *Journal of Electricity* states that, as a result of the exceptionally dry winter, many power companies in California have had to fall back upon their auxiliary steam plant to keep up their normal output. Under the usual conditions, only a quarter of the electrical power is produced by this means, but now the steam plants are providing half the total energy generated.

Walthamstow.—Bulk Supply. — The Council has arranged to give a bulk supply of electricity to the Leyton Council.

Watford.—Extensions.—The Urban District Council has received authority from the Electricity Commissioners to proceed with the expenditure of £18,420 upon extensions.

Worcester.—Rate Relief.—It is announced that the Electricity Committee is contributing £1,800, profit from the electricity undertaking, towards the local rates.

York.—Proposed Extensions.—The Council is considering extensions to the generating plant at the Foss Islands power station. These are expected to cost £55,800, and buildings £13,000.

TRAMWAY AND RAILWAY NOTES.

Bradford.—Concession to Employés.—The City Council has decided to give its tramway employés an immediate increase of 1Os. per week.

Burnley.—Sunday Working.—As the position of the Corporation with regard to coal supplies has improved, it has been decided to resume the running of tramcars on Sundays.

Continental.—Belgium.—*The Times* correspondent at Brussels announces that the terms under which the tramway strike was settled were a minimum wage of 12 fr. 5 c., as from March 11th, to be increased to 13 fr. 50 c. as soon as results permit. Fares are to be raised another 5 centimes as from April 15th.

Germany.—Addressing the shareholders at the recent meeting of the Berlin Elevated and Underground Railway Co., the chairman stated that as compared with the pre-war period, wages were seven times greater, coal 17 times more, and rails 22 times higher, &c. The fares which came into operation on April 1st were four times higher on the average, and it was impossible to foresee when the upward movement in wages and materials and the consequent advance in passenger fares would come to an end. A new labour agitation for further increases in wages had just been started by the Berlin transport workmen, whilst materials could only be obtained after a long delay and at still increasing prices. After a period of transition, the passengers, as a rule, had accommodated themselves to the higher fares, and a heavy decline in the traffic had not taken place, but a time would arrive when the growth in fares would exceed the paying capacity of a large number of the passengers.

Huddersfield.—Strike Losses.—The loss of revenue due to the strike of tramway employés is estimated at £4,000. No settlement has at present been arrived at.

Liverpool.—Annual Report.—The annual report for the year 1919 records the purchase of the Prescot Light Railway and several improvements. The total revenue for the year was £1,207,228, and working costs (including rental of leased lines) £1,029,443, leaving a gross profit of £177,785. This was apportioned as follows:—Interest, £49,974; sinking fund and repayment of loans, £52,326; and to reserve, renewal and depreciation account, £75,485. The total number of passengers carried was 208,251,496, an increase of 13,168,887 upon the previous year, and the average earnings per car-mile increased from 18·91d. to 21·46d., although the net profit fell from £169,322 to £75,485.

London.—Fare Concessions.—As from April 19th, passengers on the London County Council tramways who are not obliged to travel during those hours when the cars are crowded, will enjoy the benefit of cheaper fares. Beyond the 1d. stages, another 1d. is all that will be charged for the remainder of a journey of any distance on any one car, provided that passengers travel between the hours of 10.30 a.m. and 4.30 p.m. on cars arriving at central termini, and leaving central termini between 10 a.m. and 4 p.m. This will apply at present only to the tramways south of the Thames. Ordinary fares must be paid on Saturdays, Sundays, Good Friday, Christmas Day, Bank holidays, and all proclaimed national holidays.—*The Times.*

Increased Wages.—The employés on the underground railways have accepted the terms offered under the national railway settlement. The advances per week are as follows:—Conductors, 7s. 6d.; liftmen, 7s.; gatemen, 5s. 6d.; porters and signalmen, 5s.

Traffic Delay.—Owing to a tramcar leaving the rails at Burdett Road, E., on Wednesday last week, traffic on both up and down lines was blocked for some time.

Easter Traffic.—It is reported that during the Easter holidays the "Underground" combine of London—train, tramcar, and omnibus systems—carried a total of 14,500,000 passengers.

Newcastle-on-Tyne.—Rate Relief.—Although the chairman of the Tramways Committee states that the undertaking is running at a loss, the City Council has passed a resolution to take £14,000 for the relief of rates. Labour members opposed this item, as they considered that the travelling public would be called upon to make good any deficit in the working of the system.

Extensions.—At a meeting of the Tramways Committee, on the 9th inst., it was reported that an agreement had been arrived at with the Gosforth Park Co. to run a line of tramcars through the park. It was decided to seek Parliamentary powers to carry out the extensions at an early date.

South Shields.—Fare Increase.—Following upon the increased wages to tramwaymen, the Council proposes to increase the universal 1d. fare by 50 per cent. and the fares for children from ½d. to 1d., to take effect from April 12th. The manager, in his report on the financial situation, says that even with the increases the tramway fares in South Shields will still be the cheapest in the country. With regard to workmen's fares, no action is being taken, these having been increased a few months ago.

Spen Valley (Yorks.)—Fare Increase.—The tramway fares are to be increased in accordance with the findings of the Light Railway Commissioners, who sat at Dewsbury on Jan. 28th. The increase will be a halfpenny on fares above 1½d.

St. Helens.—Loan.—The Corporation has decided to apply for sanction to borrow £2,750 for pit extensions and fencing at the tramway depôt, and the purchase of a tower wagon.

Fare Increase.—The Corporation is applying for authority to increase the fares for the labouring classes by 50 per cent. on the present statutory charges.

United States.—Railway Electrification.—The recent electrification of the coast division of the Chicago, Milwaukee, and St. Paul Railroad completes a total of 647·4 miles of electrically-operated lines on this system. The newly-electrified section from Othello, in Central Washington, to Renton Junction, on the Puget Sound end, was opened on March 5th last. The locomotives used are equal to 2·7 steam passenger locomotives of the latest type, and will pull a passenger train of 12 coaches up the heaviest grade on the system at a speed of 25 miles per hour. All the current used in operation is generated from water power, delivered at 100,000 volts and stepped down to 3,000 volts D.C. for use on the locomotive motors. The first electrification of the Chicago, Milwaukee, and St. Paul lines (the Rocky Mountain division of 226 miles) was completed and put into operation in December, 1915. When the unelectrified gap between Othello and Avery is closed, there will be a complete electrification extending for over 860 miles.—*Journal of Electricity.*

Wakefield.—Report on Accident.—On January 29th last an accident caused the death of a goods guard at the Kirkgate Station. It appears that a fellow employé entangled his feet in a fallen telegraph wire in contact with trolley wires upon the route of the Yorkshire (West Riding) Electric Tramway Co.'s system, and the deceased, going to his colleague's assistance, received a fatal electrical shock. In his report to the Ministry of Transport, Major G. L. Hall, R.E., states that the accident was due to the lack of guard wiring to protect the trolley wires, and reports that since March, 1919, no less than 16 miles of single guard wire has been missing. The company asserts that conditions arising out of the war made it impossible to renew the wiring, but the report states that nearly a year has elapsed since the delivery of the necessary material, and that better precautions might have been taken by the company. A list of localities on the tramway system where there is a deficiency of guard wiring is being prepared by the G.P.O. authorities, which will be handed to the company, in order that the latter may furnish a report to the Ministry of Transport showing the full extent of the deficiencies and the date by which these will be remedied.

Wigan.—New Cars.—Sanction to borrow £26,000 for the purchase of 12 new double-decked, broad-gauge tramcars is being sought by the Town Council. These additions are necessitated by the great increase in the number of passengers carried on the system.

Wolverhampton.—Lorain System.—At the meeting of the Town Council, on Monday last, Alderman Craddock, chairman of the Tramways Committee, referring to the Lorain surface contact system, stated that the Corporation had now had 18 years' work on it. But for the war, the whole of the reserve fund would have been spent in renewals. The life of the system was only given as about 16 years. It was an open secret that the attention of the Ministry of Transport had been called to the system in Wolverhampton, and that it had been intimated to him that it stopped intercommunication. There was no doubt that the Ministry of Transport would at an early date send down to see what was the condition of Wolverhampton, and what was stopping intercommunication.

Wrexham.—Power Supply.—The Town Council has agreed with the Tramway Co. for the latter to pay as from January 1st last a minimum sum of £1,693 for energy up to 150,000 units in any year, subject to revision in April, 1921, when the present agreement, stipulating for the minimum charge of £1,016, expires.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Wireless Telegraphy.—The 16th annual meeting of the Associated Chambers of Commerce of the Commonwealth of Australia was held in Sydney on March 15th, when the following resolutions were submitted:—"That the Commonwealth Government remove the restrictions on the development and application of wireless communication in Australia, and permits private individuals or companies to operate stations for commercial purposes and for their own private use, subject to any reasonable regulations which might be necessary to protect all users against unnecessary interference."

"That the Commonwealth Government be asked to do the utmost to have the present Pacific cable duplicated at the earliest possible moment, and also that it arrange for wireless communication with both the United States and Canada."

Belgium.—The postal and telegraph services are gradually being restored. According to the *Echo de la Bourse* quoted by the *Economic Review*, there were in 1914, 44,564 km. of telegraph wires in use; in 1919, only 24,397 km. A tremendous amount of damage had been done by the Germans to the telegraph system. The present scarcity of copper wire adds to the difficulty of restoring the service to normal conditions. In 1914, 2,694 offices were in operation; in 1919 there were 2,295. The number of telegrams sent in 1914 was 4,407,906, as against 4,066,882 in 1913. The number of telephone subscribers before the war amounted to 54,691, as against 1,844 in January, 1919, and 30,383 in December, 1919. Almost all the pre-war post offices have been re-established.

Canada.—The annual report for 1919 of the Bell Telephone Co., of Canada, shows that during the year 4,835 miles of wire line were added to the company's plant. The long-distance lines of the company now amount to 9,514 miles of pole lines, and

7,047 miles of wire in underground and submarine cables. The number of company stations in service on December 31st, 1919, was 337,476, an increase of 34,271 for the year. In addition there were 106,231 connecting and miscellaneous stations. The total miles of wire was 964,098; the number of central offices operated, 421, and the number of employés, 11,443. The number of subscriber stations was 337,476. In underground plant the company has 608 miles of conduit, 2,309 miles of single duct, 1,059 miles of cable, and 588,000 miles of wire. Since the year 1886, the company has paid regularly a dividend at the rate of 8 per cent. per annum.—*T. & T. Age.*

Mexico.—In 1918 the national telephone and telegraph system was extended by 83,229 km. There were 528 telegraph offices, 12 telephone offices, and 21 wireless telegraph stations in existence. Receipts for the 5,591,453 messages transmitted were 4,195,845 Mexican pesos.

Public Telephone Call Boxes.—It is estimated that there are 3,576 public telephone call boxes in London. When the call fee was increased from 2d. to 3d. during the early part of the war period, the use of public call boxes decreased by about 50 per cent. Since the Armistice, however, the use has steadily grown until to-day it exceeds previous records. The number of call boxes is to be increased, and also the number of attendants, who will largely replace the penny-in-the-slot system. It is intended to keep call boxes open to 11 p.m.

South America.—During the first week in March some of the submarine cables along the west coast of South America were interrupted, due to earthquakes. Cables between Iquique and the Peruvian border were interrupted for a short time, but the delay to traffic was not serious.—*T. and T. Age.*

Telegraph Convention.—There are 49 countries represented in the list of adherents to the Telegraph Convention. Of telegraph companies, there are 18 which adhere, 15 which, though not official adherents, conform generally to the Regulations, and correspond regularly with the Bureau, and five companies which generally only correspond with the Bureau through companies in the other groups. The 49 countries represent an area of 73,261,282 sq. miles, and a population of 1,114,866,650.

Wireless Speech to Rome.—Verbal messages of greeting, demonstrating the possibility of long-distance wireless telephony, were transmitted to the principal Italian newspapers on April 9th from England by several Italian journalists resident in London. The Marconi Co.'s long-distance apparatus at Chelmsford was employed for this purpose, and the several messages were received at Centocelle, about 4 miles from Rome, by editorial representatives of the interested papers.

Immediately following the demonstration, a reply was received by wireless telegraph.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Auckland (N.Z.).—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London, E.C. 2.

Australia. — Perth. — May 3rd. Postmaster-General's Department. Insulators, bolts, brackets, &c. Schedule 673. (April 2nd.)

May 14th. Government of Western Australia. One 7,500-kw. turbo-alternator and condensing plant. (April 9th.)

Belgium.—May 1st. Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels.—325 milli-amperemeters, 400 Morse wheels, 500 Morse receivers, and a quantity of miscellaneous telegraph apparatus. Particulars (Cahier des Charges Special No. 521) from the above address.

June 29th. Municipal Authorities of Antwerp. Two electric cranes of respectively 30 and 10-tons capacity, for one of the dry docks at the Port. Particulars, 4 fr., from the Hotel de Ville, Antwerp.

May 28th. Municipal Authorities of Antwerp. Electrical equipment of three transformer cabins at the docks. Particulars, for 2 fr., from the Hotel de Ville, Antwerp.

Canterbury.—April 19th. Electricity Department. One 1,000-kw. three-phase turbo-alternator, surface condensing plant, two rotary converters, superheater, &c. (March 26th.)

Cardiff.—April 29th. Corporation. One 5,000-kw. turbo-alternator and condensing plant. (April 9th.)

Carlisle.—April 27th. Electricity Department. One 1,000-kw. converter, switchgear for converter, E.H.T. feeder switchgear. (See this issue.)

Darlington.—April 19th. Electricity Department. One water-tube boiler. (April 2nd.)

Dartford.—April 26th. Urban District Council. One water-tube boiler and mechanical stoker; bus-bars. (See this issue.)

Dublin.—April 24th. Electricity Supply Committee. Seven truck-type switch cubicles for use on a three-phase 50-period 5,000 v. system. (See this issue.)

Ebbw Vale.—April 19th. Urban District Council. One 5-10-H.P. single-pulley endless rope electric haulage gear. Mr. Thos. Hughes, Clerk, Council Offices.

Edinburgh.—April 26th. Electricity Supply Department. E.H.T. paper-insulated lead-covered cables. (April 2nd.)

Leigh.—Lancs. Electricity Department. One 2,500-kw. turbo-alternator; E.H.T. & L.T. switchgear; one 500-kw. rotary converter. (See this issue.)

Portsmouth.—April 26th. Board of Guardians. Electrical installation at the Children's Home, Milton. (See this issue.)

Spain.—The municipal authorities of Almaden have lately invited tenders for the concession for the electric lighting of the town during a period of 10 years.

Sunderland.—April 28th. Electricity Department. Water-tube boilers, superheaters, stokers, economisers and chimneys; one 1,000-kw. rotary converter. Specifications, &c. (£1 each), from General Manager, Electricity Works, Dunning Street.

Tasmania.—Launceston.—June 7th. City Council. One 1,000-k.v.a. hydro turbo-alternator, with switchgear. City Electrical Engineer, Town Hall, Launceston.

Uruguay.—August 7th. Department of Posts, Telegraphs and Telephones. Construction of a national telephone system for the Department of Montevideo. Particulars from the Uruguayan Legation in London, 3, Elvaston Place, South Kensington, S.W.

Whitby.—Electricity Department. Replacing economiser, boiler feed pump, pipework; converting of old dry duct into cooling pond. (See this issue.)

CLOSED.

Bradford.—Electricity Committee :—

Cast-iron circulating piping for Allen's pumps and condenser—Stanton Ironworks Co., Ltd.
1½-ton overhead runway system—Vaughan Crane Co., Ltd.

Kettering.—Urban District Council. The following prices were quoted for a '6 concentric, paper-insulated, lead-covered feeder cable with feeder pillar :—

Macintosh Cable Co. ..	£4,310	No provisional sum included.
Pirelli Cable Co.	3,850	
Glover & Co.	3,567	
British Insulated	3,522	
Johnson & Phillips	3,518	
Callender's Cable	3,478	Plus £100 provisional sum.
Union Cable Co.	3,461	
Western Electric	3,458	
Siemens Bros.	3,350	

The Cleckheaton Council offered a '55 concentric, paper-insulated, lead-covered, double-sheathed, steel-armoured cable at 26s. per yard. Subject to certain reservations, this price has been accepted.

Maidstone.—Town Council :—

Cables for the supply to Snodland—Union Cable Co., £39,940 (subject to revision for fall in the prices of copper and lead).

Manchester.—Tramways Committee. Accepted :—

Tramcar controllers—English Electric Co., Ltd.

Stores for 12 Months.

Motor and controller parts, &c.—British Thomson-Houston Co., Ltd.; English Electric Co., Ltd.; Metropolitan-Vickers Electric Co., Ltd
Insulating material; silumanite, insulator—L. Andrew & Co.; Griffith Bros. & Co.
Grids for resistances—Electro-Mechanical Brake Co., Ltd.; H. Wallwork and Co.
Armatures and field cores, &c.—Manchester Armature Repair Co., Ltd.; Metropolitan-Vickers Electrical Co., Ltd.; P. R. Jackson & Co., Ltd.; English Electric Co., Ltd.
Phosphor bronze springs, &c.—British Thomson-Houston Co., Ltd.; Tierney Wood & Co.; Kay & Co.
Controller fingers, &c.—Forest City Electric Services Supply Co., Ltd.; Dyer & Young; Fairless Engineering Supplies Co.
Steel trolley poles—Brecknell Munro & Rogers, Ltd.
Electric lamps—General Electric Co., Ltd.; Drake & Gorham, Ltd.
Carbon brushes—General Electric Co., Ltd.; J. Eades.
Overhead equipment material—A. Wiseman, Ltd.
Cables—W. T. Glover & Co.
Copper cable, strip and wire—F. Smith & Co.
Brass wire strip and sheet—C. Clifford & Son.
Galv.-steel cable and wire—F. Smith & Co. (Wire Manufacturers), Ltd.
Bell wire—Macintosh Cable Co., Ltd.
Thermit welding—Thermit, Ltd.

Waterworks Committee. Accepted :—

Electrically-driven centrifugal pump—Holden & Brooke, Ltd.

Hydro-electric installation. Thirlmere :—

Turbine dynamo, &c.—Gilbert Gilkes & Co., Ltd.
Storage battery reversible booster, &c.—D.P. Battery Co., Ltd.
Motors, starting panels, &c.—Lancaster Dynamo and Motor Co., Ltd.
Cables—Macintosh Cable Co., Ltd.

Electricity Committee. Accepted :—

Two turntables for Stuart Street station—F. Theaker, Ltd.
Three three-wire balancers for Dickinson Street station—Bruce Peebles and Co., Ltd.
One traction motor-driven booster set, with regulating and starting switchgear, for Dickinson Street station—Lancashire Dynamo and Motor Co., Ltd.
One 1,500-kw. motor converter, switchgear, and resistances for Dickinson Street—Bruce Peebles & Co., Ltd.
Two 600-k.v.a. static transformers for sub-station—Metropolitan-Vickers Electrical Co., Ltd.
Two 1,200/1,500-kw. motor converters, and four 1,500-kw. motor converters for sub-stations—Bruce Peebles & Co., Ltd.
Two-ton electric lorry—Drake & Gorham, Ltd.
15-cwt. electric van—Electromobile (Leeds), Ltd.
Cable—Western Electric Co., Ltd.
Tee and tail-end boxes—Siemens Bros. & Co., Ltd.

Electrically-operated wagon tippers for Barton—Babcock & Wilcox, Ltd.
Switchgear equipments—Park Royal Engineering Works, Ltd.
H.T. switchgear extensions—Bertram Thomas.
Fuse-boxes—Siemens Bros. & Co., Ltd.

In connection with the Barton station, the following main contracts have been placed :—

Two 25,000-kw. turbo-alternators—Metropolitan-Vickers Electrical Co., Ltd.
Two sets of main condensing plants—Richardsons, Westgarth & Co., Ltd.
Two house service turbo-alternators—British Thomson-Houston Co.
Four complete boiler-house equipments—Babcock & Wilcox, Ltd.
Coal and coke conveying plants—W. J. Jenkins & Co., Ltd.

Salford.—Tramways Committee. Accepted :—

One set hydraulic car-lifting jacks, £365—Messrs. Youngs.
Welding and retreading 1,000 joints on the tramway track (approx), £2,300—Rail Welding Co.
Five single-deck omnibus chassis, £1,240 each—Leyland Motors, Ltd.
Five single-deck omnibus bodies, £570 each—English Electric Co., Ltd.
Dry cells—Siemens Bros. & Co., Ltd.
Two Q.B.1, Form B.3, tramcar controllers, £193—English Electric Co., Ltd.
Metal-filament lamps, £213—Drake & Gorham, Ltd.
Armature and field coils, £275—Barratt & Thornton.
12 Westinghouse motors (second-hand), £1,220—Equipment and Engineering Co., Ltd.

Electricity Committee. Accepted :—

Five sets of stokers, £1,375—E. Bennis & Co ; Ltd.
One 1,000-kw. rotary converter, £5,860; E.H.T. switchgear, at Pendleton, £2,525; cubicle for the potential transformer, £87; air cooler in connection with the 5,000-kw. turbo-alternator set, £1,545—Metropolitan-Vickers Electrical Co., Ltd.
300 K.V.A. transformer—Ferranti, Ltd.
Rotary screening plant, £742—Ledward & Beckett, Ltd.
Motor-driven pumping set, £1,368—Mather & Platt, Ltd.
Steam ejector and extraction pump, £786 ; one 500-kw. rotary converter, £3,770—Metropolitan-Vickers Electrical Co., Ltd.
Two Weir "Roto Feed" pumps and accessories, £1,149—G. & J. Weir, Ltd.
E.H.T. switch cubicle, £230—Metropolitan-Vickers Electrical Co., Ltd.

Sunderland.—Electricity Committee. Accepted :—

Service, E.H.T. and L.T. cable—B.I. & H. Cables, Ltd.
Two 250-K.V.A. transformers—Brush Electrical Engineering Co., Ltd.
Capping and cable troughing—J. Thompson & Co.
Switchgear—Ferguson, Pailin & Co., Ltd.

Watford.—Urban District Council :—

Laying electric light fittings to 40 houses. Eight points per house.—J. N. Connare, £318.

Wolverhampton.—Team Committee. Recommended.

Three 3½-ton Orwell electric vehicles—Ransomes, Sims & Jeffries, Ltd., at £1,558 each.

York.—Electricity Committee :—

Hydro-electric power works at Linton Locks—The English Electric Manufacturing Co., £53,057. (This is a revised tender showing a reduction of £11,628, owing to three turbines being included instead of four.)
Cables for Linton Lock—Callender's Cable Co., £9,445.
Turbo-alternator and condenser for electricity works, Foss Island—Oerlikon Co., £27,692.

FORTHCOMING EVENTS.

Technical Inspection Association.—Friday, April 16th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Paper on "Labour Unrest—its Causes and its Cure," by Mr. F. R. Wade.

Birmingham and District Electric Club.—Saturday, April 17th. At the Grand Hotel, Birmingham. At 7 p.m. Paper on "Electric Heating and Cooking," by Mr. F. F. D. Davidson.

Royal Institution of Great Britain.—Saturday, April 17th. At Albemarle Street, W. At 3 p.m. Lecture on "The Thermionic Vacuum Tube as Detector, Amplifier and Generator of Electrical Oscillations," by Prof. W. H. Eccles.

Tuesday, April 20th. At 3 p.m. Lecture on "Recent Advances in X-Ray Work," by Major G. W. C. Kaye.

Royal Society of Arts.—Monday, April 19th. At John Street, Adelphi, W.C., At 8 p.m. Cantor lecture "Aluminium and its Alloys," by Dr. W. Rosenhain, F.R.S. (Lecture II.)

Institution of Civil Engineers.—Tuesday, April 20th. At Great George Street, S.W. At 5.30 p.m. "James Forrest" Lecture on "Coal Conservation in the United Kingdom," by Sir Dugald Clerk, F.R.S.

Institution of Electrical Engineers.—Monday, April 19th. Informal meeting. At the Institute of Patent Agents. At 7 p.m. Discussion on "Group *versus* Individual Driving," to be opened by Mr. G. H. Ayres.

(Liverpool Sub-Centre.)—Monday, April 19th. At the Liverpool University. At 7.30 p.m. Eleventh Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

(North-Eastern Centre.)—Monday, April 19th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Lecture on "Electricity in the Western War Zone," by Major T. Rich. Annual general meeting.

Friday, April 23rd. At 7.15 p.m. Eleventh Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

(North-Midland Centre.)—Tuesday, April 20th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "The Protection of Alternating-current Distribution Systems without the use of Special Conductors," by Major K. Edgcumbe.

(North-Western Centre.)—Tuesday, April 20th. At 7 p.m. At the Manchester College of Technology. Eleventh Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

(South-Midland Centre.)—Wednesday, April 21st. At the University, Birmingham. At 7 p.m. Eleventh Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

Illuminating Engineering Society.—Tuesday, April 20th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "The Lighting of Churches," to be opened by Mr. J. Darch.

Industrial League and Council.—Wednesday, April 21st. At the Caxton Hall, Westminster, S.W. At 7.30 p.m. Lecture on "A National Scheme of Profit Sharing," by Mr. H. W. Jordan.

Edinburgh Electrical Society.—Wednesday, April 21st. At the Philosophical Institution. At 7.30 p.m. Paper on "The Telephone," by Mr. J. McBrown.

Institution of Mechanical Engineers.—Friday, April 23rd. At the Institution, Storey's Gate, S.W. At 6 p.m. General meeting.

NOTES.

Income-Tax.—A movement is on foot to secure for scientific workers abatements in respect of their professional expenses. The General Secretary of the British Association of Chemists, Bedford House, York Place, London, W., would be glad to receive communications from those concerned.

Prize Competition.—A prize competition, instituted by the Società Generale Italiana-Edison di Elettricita, for an electric kitchen, due for decision at the end of February, has been postponed till the end of September. The reason for the postponement is the increase of the award caused by the offer of 20,000 lire by the Compania Italo-Argentina de Electricidad towards the prize, making the total 50,000 lire. Persons desirous of further information should write Direzione della Società Edison, in Milan, Via S. Radegonda 10.

Electrical Artificers.—It is announced that acting electrical artificers drafted to sea prior to the completion of their course owing to sudden drafting requirements may be confirmed in their rating at the end of 12 months' service, notwithstanding that they have not completed their course in a torpedo school, provided they obtain from the lieutenant (T.) of their ship the necessary certificate. As occasion offers, however, these men will be required to complete their torpedo school course.

Inquiry.—A correspondent who has water-power plant available day and night invites suggestions for its utilisation, not involving much cartage of material.

The Army Electric Lighting School.—According to the Army Estimates for 1920-21, the School of Electric Lighting will cost the sum of £3,845 in the coming year, as against £18,959 last year. The school, which will accommodate 20 officers and 300 other ranks, will be staffed by one commandant instructor at £1,000 per annum, two instructors at £1,315, two assistant instructors £1,130, and the cost of the military and civilian subordinate staffs will be £400. The above figures, however, are not inclusive of travelling, accommodation, stationery, and miscellaneous expenses, which last year amounted to £7,050.

The estimate for the Anti-Aircraft Searchlight and Sound Locator School is put at £1,785, exclusive of travelling, accommodation, stationery, and miscellaneous expenses, and the cost of military and civilian subordinate staff. Last year this school cost the British taxpayer £13,200.

West African Wireless Station.—The station at Bathurst, West Africa, is to be provided with additional house accommodation for the staff maintained there at the cost of the Admiralty. This year about £8,400 will be spent out of £15,800 required to complete the scheme.

A Strike at Runcorn.—Our Liverpool correspondent writes :—"Owing to the strike at Runcorn, the Mersey Power Co., which supplies electricity to all the large chemical works and factories in the neighbourhood, has had to cut down its output to the limits of the necessities of public utility services. Works without their own generating plant were badly placed, and were compelled to stop hundreds of men. Other works carried on with the electrical generating plant they had on the premises, but, of course, this was not sufficient to supply their full needs. The Helsby Cable Works were affected, and had their small generator in commission. Some of the local places of amusement had to modify their arrangements owing to inadequacy of supplies. The ten minutes' service of the Runcorn transporter bridge had to be modified to a half-hourly service. At the time of writing the situation shows signs of improvement, and arrangements have been made by means of which the Mersey Power Co. will obtain coal on barges from Winsford, along the River Weaver, to the generating station at Runcorn, a journey of 15 miles. These supplies, if continued, will enable the company to supply the present restricted service, provided no further complications ensue."

Fatality.—At an inquest held at Newcastle on April 5th, it was stated that on 3rd inst. John Robson, a tramcar motorman, was in charge of a car on the Gosforth route, when his head was struck by a standard while the car was travelling. A pedestrian, who gave evidence, said that when he saw the car approaching, he noticed the driver was lying over the right side of the car as though he had fainted. As the car was going along, the man's head struck a tramway standard. Witness jumped on the car, knocked off the rear switch, and put on the hand brake, while the conductor rushed to the front of the car and applied the brake. There was no explanation of what had occurred to the driver prior to his being struck by the standard. Death was consequent upon a fractured skull, and a verdict of "Accidental Death" was returned.

Appointments Vacant.—Shift engineer (£220), for the Borough of Torquay Electricity Department; instructor in wiremen's work, for the Leeds Technical School; shift engineer (79s. 6d.), for the City of Peterborough Electricity Department; assistant mains engineer (£260), meter superintendent (£260), for the Walsall Corporation Electricity Department; draughtsman, for the Rotherham Corporation Electricity Department; meter tester (40s. + E.P.E.A. awards), for the Salford Borough Council Electricity Department; shift engineers, junior shift engineers, switchboard attendants, and general assistants, for the Southampton Corporation Electricity Department; mains assistant (45s. + 20 per cent. + £120), plumber jointer (district rate), switchboard improvers (40s.), for the Radcliffe Urban District Council Electricity Works; station engineer and fitter, for the Londonderry Electric Supply Station. See our advertisement pages to-day.

I.E.C. Rules for Electrical Machinery.—We have received from Mr. C. le Maistre, general secretary of the International Electrotechnical Commission, a copy of Vol. I of the I.E.C. Rules for Electrical Machinery, Publication 34, now issued. These rules apply to rotating machines of which the terminal pressure does not exceed 5,000 volts, or of which the rated output does not exceed 750 K.V.A., or of which the stator cores do not exceed 50 cm. in length axially, and to all transformers which are not water-cooled. Copies can be had from the Secretary, 28, Victoria Street, S.W. 1, price 2s. 2d. post free. A discussion on the rules appears elsewhere in this issue.

As we go to press we have received an account of the meetings of the Advisory Committees of the I.E.C. held at Brussels, from March 27th to 31st. In addition to the secretaries, about 35 delegates were present, and were welcomed on behalf of the Belgian Electrotechnical Committee, by M. Omer de Bast, of the Institut Montefiore. Visits were paid to the Yser battlefields, and the devastated areas, including Courtrai, Nieuport, Dixmude and Ypres. The meetings dealt with Rating Rules, Graphical Symbols, Nomenclature and Standard Pressures; particulars will be published later. It is proposed to hold the next meeting of these Committees in Paris, in November.

Educational.—University of Liverpool.—In a recent appeal for funds to enable it to carry out its valuable work of advanced education, the University utilises a method of publicity that cannot fail to appeal to all classes. In a publication, bearing the title "A Move for National Efficiency," the scope of the University's schemes is amply set forth, and the necessity of such an important institution as a factor of national development and progress is brought home to the reader. The position held by Liverpool in British commerce is remarked upon, and every reader is assured that he or she is greatly concerned with, and partly dependent upon, the great National port. Enclosed with the pamphlet is a subscription form affording three different methods of providing the necessary financial aid.

Manchester University.—The Manchester Chamber of Commerce has been asked to appeal to the business men of the city for their aid in maintaining the high standard attained by the University. A big publicity campaign is being organised for the sale of University Bonds (which are irredeemable and bear no interest), and many of the students will offer these in the City's public places. Other features of the movement are short addresses at music halls and kinemas, and a pageant organised by the students. It is hoped by these methods to raise £500,000.

King's College, London.—At a meeting of old students, on March 9th, it was decided to form an Old Students' Section of the Engineering Society as a branch of the King's College Old Students' Association. Mr. C. H. Wordingham, C.B.E., was elected president, and Prof. Ernest Wilson and Brigadier-General H. Mowat vice-presidents. An inaugural luncheon will be held at the Holborn Restaurant, at 12.45 p.m., on May 1st, at which the Committee's plans and proposals will be fully explained and suggestions invited from those present. It is hoped that all former students of the engineering faculty will make a point of attending. Further particulars of the Association can be obtained from Mr. A. N. Gardiner, 2, The College, Epsom.

Magnetic Field Submarine Detection.—A paper describing a series of interesting tests of the disturbance caused in a uniform alternating magnetic field by an incoming magnetic mass, in connection with the development of a device for the detection of enemy submarines, appears in the March issue, and will be concluded in the April issue, 1920, of the *Journal* of the American I.E.E. The principle of the device described, which appears to be the most promising so far proposed, will be understood from the following: An alternating magnetic field is set up by an A.C. magnet having an open magnetic circuit; a straight bar magnet so designed as to give as far-reaching and as strong a field as is practicable. In the field of this magnet, and as far away from it as is possible, is located a detecting coil. The latter may be located with its plane parallel to the lines of force set up by the magnet, in which case it will theoretically have no voltage induced in it by the magnet itself; or it may be located with its plane not parallel to the lines of force, in which case the voltage induced in it by the alternating field set up by the magnet must be balanced out by another E.M.F. exactly opposite in phase and magnitude to the voltage induced in the detecting coil. If the conditions aimed at are realised, there will, in either of these cases, be no resultant E.M.F. in the circuit including the detecting coil, and no indication thereof in such means as may be employed for detecting an alternating E.M.F. in this circuit. If, now, a submarine comes into the field set up by the magnet, it will disturb the field existing around the detecting coil, with the result that there will be an alternating voltage produced in the detecting coil circuit which will indicate the presence of the submarine, and may also indicate its location. The principal conclusions come to from the results of the tests were: That detection tests in the laboratory with submarine models 10 ft. long are in agreement with the underlying theory, and may be used as a basis for the design of larger equipment. Detection tests on steel hulls from shore equipment and from equipment installed on a wooden submarine chaser 10 ft. long, are in good accord with results predicted from a formula developed in the laboratory tests. By sufficient increases in the size of the equipment it is possible, in quiet water, to detect a steel vessel 200 ft. long, at a distance of 500 ft.; the weight of the equipment required would be about 8,000 lb. Distances of detection in the neighbourhood of 200 ft. were obtained in quiet water with equipment weighing 4,500 lb. installed in a wooden submarine chaser 110 ft. long. The reliability of the system of detection is immediately impaired by motion of the vessel, due to her engines, heavy sea, and changes of course, or speed. The results mentioned involve the use of amplifying valves for enlarging the signal. Without the amplifier the distances of detection are very short, even when a large magnet or large detecting coil and an extremely sensitive detecting instrument are used. Disturbances in the detecting system fix the limit for increasing sensitivity; these disturbances are amplified, and appear in the detecting instrument as larger than the signal sought.

Water Power in British Guiana.—The publication of the preliminary report upon the water power resources of British Guiana by Mr. Stafford X. Comber, M.Am.Soc.C.E., marks the first step of the Government in this direction. The surveys were carried out under most difficult circumstances, not the least of which was the heaviest rainfall experienced for the forty years during which records have been kept. British Guiana is extremely rich in mineral deposits which have scarcely been touched, and the advent of electricity would open up immense sources of wealth. In the coastal area the cane sugar industry is threatened by an acute shortage of labour, and the advantages of applying electricity to this and other industries in the more thickly populated areas are incalculable. Mr. Comber, accompanied by a small party of Akawais Indians, proceeded 150 miles into the jungle, and made surveys at numerous points, chiefly on the Essequebo, Cuyuni, and Demarara rivers. The variation of the flow of these rivers at different seasons is, of course, very marked, and the engineer estimates that the volume per second of the Cuyuni varies from 29,000 to 93,000 cu. ft.; of the Essequebo from 68,000 to 250,000 cu. ft., and that of the Demarara from 1,200 to 5,000 cu. ft. at the Great Falls, and from 1,700 to 6,500 cu. ft. at Mallali. The total drop of the part of the Cuyuni examined is about 73 ft. The total drop of the Essequebo between Moneri and Aretaka is estimated to be 67 ft., and that of the Demerara, between Ororu Maralli and Little Mallali Rapid, is 78 ft. These heads could be economically increased by artificial works, which would at the same time regulate the flow and provide the necessary storage. In summing up the possibilities presented by these rivers, Mr. Comber calculates that, allowing a basis of 95 per cent. at the turbine shaft, the following amounts of horse-power are available: Cuyuni river 285,000, Essequebo 475,000, and Demerara 38,000. The ultimate delivery of power within a two hundred mile radius, which, it is stated, is under-estimated if anything, would probably be 156,000 H.P. from the Cuyuni, 273,000 H.P. from the Essequebo, and 21,000 H.P. from the Demerara. In such a hasty report it is impossible to give reliable estimates of cost, but the expert says that, judging from experience, consumers on the coast should be able to receive power at from .75 to 3.75 cents per unit. In order to secure reasonably reliable estimates of the cost of the necessary plant, Mr. Comber recommends the further survey of seven specific sites, and the establishment of gauging stations at various points to enable a complete and accurate record of velocities, &c., to be compiled, remarking in conclusion that "it is impossible to emphasise too strongly the advisability of at once commencing the recording of data concerning the flow of rivers having power possibilities." The plates accompanying the report are maps of the several districts under survey, and photographs of falls and rapids, which although generally taken under difficulties are extremely good.

Electrical Development in China.—Details of a scheme for promoting the sale of energy are given in a report by the U.S. Consul at Foochow. The local lighting company purchased a number of rice-polishing machines and offered them for hire to the native rice mills. Special meters were installed, and energy was sold at less than the lighting rate. The same company was recently planning to install an electric tramway system. Intending British suppliers of material will have to face fairly firmly established competition, both from the United States and Japan. There is a local telephone company known as the Foochow Telephone Co., run by the same group as the Foochow Electric Light Co.

There are four electric light plants in the Swatow district, the one at Chaochowfu having now commenced operation. The Swatow Kaiming Electric Light Co. had another profitable year, and declared its usual dividend of 8 per cent. in addition to adding a good sum to its surplus. During the year the number of lights supplied rose from 15,000 to 19,200, due chiefly to installations in gambling houses. Four of the five dynamos are in use every night. The Hing-ning and Kaying plants have a capacity of between 2,000 and 3,000 lamps, while that of the Chaochowfu plant is five thousand 20-watt lamps.

A number of American light plants have been sold in the district, most of which are being operated on a commercial basis at a charge of 3s. to 4s. per lamp. Their small cost especially appeals to the Chinese, with whom electric lighting has become very popular, and during the next few years considerable development along this line should occur.

Turbo-alternator Short-circuit Tests.—A series of tests are described in the *General Electric Review* of March, 1920, that were made for the purpose of rounding off the data that have been compiled on the behaviour of alternators under short-circuit conditions. The characteristics of alternators with smooth core rotors were not so well known as those of definite pole machines. The tests, carried out on a 10,000-K.V.A. turbo-alternator, were carefully conducted under numerous conditions of short circuit, with various arrangements of reactors in circuit, and with no reactors in circuit. Special precautions were taken to eliminate errors, and meter readings were taken as a check on oscillograph records. While there are not yet enough data at hand to decide finally the various points brought out in the tests, yet the following conclusions are apparently well established. (1) Within all practical accuracy the effective symmetrical initial short-circuit current I (effective amperes) of a turbo-generator equals: (*a*) $I = [100/x_g] \times I_n$ on no-load normal voltage with no external reactance; (*b*) $I = [100/(x_g + x_e)] \times I_n$ on no-load normal voltage with external reactance; (*c*) $I = [100/x_g + 1] \times I_n$ on full-load zero power factor and with no external reactance; (*d*) $I = [100/(x_g + x_e) + 1] \times I_n$ on full-load zero power factor and with external reactance; (*e*) $I = \sqrt{[100/x_g]^2 + (1)^2}$ on full-load unity power factor with no external reactance, where E = normal voltage per phase of the generator; I_n = normal current per phase of the generator; and x_e = per cent. external reactance = $R \times I_n \times 100/E$; x_g = per cent. transient reactance of the generator; R = ohms external reactance.

2. The percentage synchronous reactance, x_s, of the generator equals: $x_s = F_1/F_E \times 100$ per cent. at F_E amperes, where F_1 = field current required to give normal current on synchronous impedance tests, and F_E = field current no-load normal voltage assuming a straight line saturation, *i.e.*, air gap amperes. Then the sustained short circuit current with external reactance and F_E amperes field is $I_s = [100/(x_s + x_e)] \times I_n \times F_E/F_E$. That is, external reactance is added directly to the internal reactance of the generator in the same way as for the instantaneous values.

3. It is close enough for practical purposes to consider that the per cent. leakage reactance varies inversely with the voltage.

4. As far as the first quarter second after short circuit is concerned, it makes no difference whether the generator is regulated by hand or by means of an automatic voltage regulator.

5. Adding external reactance to a generator circuit equal to the initial reactance of the machine reduces to one-half the instantaneous short-circuit current. At the end of one second, however, the current is practically the same whether the external reactance is connected in or not, if the leakage reactance of the machine is small compared with the synchronous reactance.

6. All the foregoing conclusions apply to definite pole generators as well as to turbo-generators, except that in the former machines it is very essential that the field leakage reactance be included in the transient reactance, while on the machine tested, neglecting the field reactance did not introduce any appreciable error.

Colliery Underground Transport.—A study of underground haulage in collieries was written in 1914 by Mr. F. Defize and contributed to the *Revue Universelle des Mines*, Liege. According to the Inst. C.E. *Abstracts of Papers in Scientific Transactions and Periodicals*, the author deals with the question both from the engineering and the economical point of view, but, as economical considerations determine the system adopted, his emphasis is mainly on that side. Discussing the conditions under which the work has to be carried on, he compares costs in terms of the tonne-kilometre (t-km.)*, and points out the advantages of the different types of locomotives in common use. Experience has shown that a fair day's work for a horse, which the author takes as a term of comparison, is about 50 t.-km. This product of distance and load he calls the "traffic intensity." The benzine locomotives of 8 and 12 H.P., in common use in the Belgian collieries, have a tractive power on the level of 270 and 400 kg. respectively, and a speed, with a normal load, of 6 km. (3.73 miles) per hour. The running costs per day, which are set out in detail for each system, amount to from 23 to 32 francs a day at pre-war prices. It appears that the benzine locomotive becomes, as the traffic intensity rises, rapidly more economical than horse haulage, and that its superiority begins when the traffic intensity reaches 120 t.-km. The question of electric haulage with accumulators—a system which has never made much headway in favour—is treated with the same fullness. The speed of the accumulator locomotive under a normal load is about 10 km. (6.21 miles) per hour. It has an advantage over the benzine motor in being less in height—1 m. (3 ft. 3.37 in.), against 1.4 m. (4 ft. 7.14 in.). Compared with horse haulage it becomes superior in economical working when the traffic exceeds 240 t.-km. The compressed-air locomotive has found a wider application, chiefly because it is not a source of danger in an explosive atmosphere. Moreover its exhaust tends to purify and cool rather than to vitiate and heat the air of the mine. This locomotive possesses the merit of small dimensions, which makes it suitable for thin seams. Its speed is from 10 to 12 km. (6.2 to 7.45 miles) an hour. A compressor capable of compressing from 5 to 6 cu. m. (176·6 to 211.9 cu. ft.) a minute is sufficient to run one locomotive. The running costs, which are high for a small output, decrease rapidly as the loads to be hauled increase. Its superiority over horse haulage, from the economical standpoint, begins when the traffic intensity reaches 220 t.-km. The electric locomotive supplied with current from a power station is steadily winning a foremost position, due to the many advantages it possesses over the other systems. It is easily controlled. Its speed, up to 12 km. (7.45 miles) an hour, can be regulated with precision. For a given power it is lighter than any other. It occupies less space, and is more easily kept in good order. The current wires are simple and quickly fixed in position, and when installed may be used for lighting and shot-firing. The cost of an installation is less than half that of the compressed-air system. The electric locomotive, moreover, does not heat or vitiate the atmosphere of the mine. But the possibility of sparking makes it unsuitable for use in a fiery mine. From the economical point of view it is superior to all other forms of motor, largely because it makes possible the concentration of power in one centre. The return circuit is usually through the rails, the joints of which are connected by copper wire; D.C. is preferred to A.C. As an illustration the author describes an installation in a mine in the United States. It appears that electric haulage begins to become economically superior to horse-haulage when the traffic intensity reaches about 150 t.-km.

* 1 tonne-kilometre = 0.612 ton-mile.

"Colloil" Liquid Fuel.—It has long been realised that if a commercially practicable process could be devised for combining fuel, oil, and/or coal tar or coal dust in such a manner as to permit of their handling and use in liquid fuel burners for steam raising, &c., in the same manner as fuel oil alone, there would be a large demand for the product or process. As evidence of this the British Admiralty offered a prize of £2,000 for a combined coal tar and fuel-oil fuel which was not won. American engineers have attempted to use coal and oil, but the cost of grinding in endeavouring to obtain a perfect colloidal suspension has proved prohibitive, taking about three weeks to prepare. British railways, notably the Great Central, have likewise experimented.

The Calvert "Colloil" system provides means whereby dust fuels, especially coal or coke dusts, can be handled, stored, and burnt as readily, it is claimed, as oil fuel alone, and in a dustless and ashless manner. Further, it is claimed that the full thermal value of the coal dust is obtained, more than by burning the expensive solid coal, and without the labour of stoking, and one ton of colloil dust only occupied the space of ¼ ton of solid coal.

The Calvert system treats the solid fuels in such a manner as to render them sufficiently levigated for this purpose, which can be done at a cheap rate. They are then incorporated with a liquid fuel or carrier, and tanked and handled in such a manner as to permit of their use in the same way as would obtain with oil fuel.

Broadly, the process consists of, first, treating (levigating) the fuel, secondly, simple agitation in the storage tanks by air, gas, or mechanical means, and thirdly, control of the fuel supply to the burners.

The calorific value is high, and the fuel is claimed to be dustless and practically ashless. The same applies to coke dust, gas or tar oils, charcoal from peat, brown lignite, sawdust, rice or coffee husks, which may form other components in addition to the fuel-oil-coal "colloil," or as substitute for one of the solid components. The liquid carriers may be oil, alcohol, water or mixtures thereof. The substance may be prepared in concentrated paste form, five parts coal, one of oil, and the balance of the oil (four parts or more) added by simple stirring at another place if found more convenient for transit reasons. The liquid 50 per cent. colloil can be pumped and railway tanked as fuel oil can. The paste may save in transport in other ways if 40 per cent. of the oil is available elsewhere, though the packing of the paste involves more expense in containers and handling.

Coal dust in aqueous suspension is termed "Colleau." Though, of course, the thermal value is much lower it is high in proportion to the cost of raw materials and labour of stoking. It consists of 50 per cent. levigated coal and 50 per cent. water. Taking the dust and cost of treatment at 15s. a ton and allowing for heat losses (coal consumed) in vaporising the containing water, there is still, it is claimed, a heating value equal to 15 cwt. of steam coal, value £3, per ton of "Colleau" at 15s., apart from labour saving.

In connection with internal combustion engines "Colloil" specially prepared can be used as fuel in the Diesel type of engine wherein heavy oils are injected into the cylinder, with a saving in fuel costs equivalent to the costs of the fuel used.

It is estimated that a plant capable of treating 100 tons of coal dust per week so as to enable it to be used as colloil or colleau will cost £2,000 to £2,500 complete erected; 3s. per ton is allowed for materials used, power, and overhead charges, and 2s. for labour. The costs do not include handling the product after it leaves the machine, and assume the dust delivered to the plant. The product is made in about three hours.

The fuel and system are covered by patents, and the name "Colloil" is a registered trade mark. The system patent embodies devices for storing, feeding, and burning the fuel so that the levigated system is maintained and control of the fuel flow obtained without risk of stopping.

Birmingham Trades Exhibition.—We are indebted to Mr. U. Y. Anderson, commercial engineer, for the accompanying illustration which shows the stand of the City of Birmingham Electric Supply Department at the National Trades Exhibition. On this stand, which is attracting the attention of large numbers of visitors each day, are shown many examples of the latest adaptations of electricity to domestic uses, and it is, therefore, of special interest to the numerous purchasers of houses, and to architects and builders in connection with the many housing schemes now in hand. The stand contains exhibits by the following firms: Messrs. Benham & Sons, Ltd., Belling & Co., British Thomson-Houston Co., Ltd., Dental Manufacturing Co., Ltd., General Electric Co., Ltd., and Premier Electric Heaters, Ltd., there

Corporation Stand at a Birmingham Show.

being on view a large selection of table lamps, bronze and copper fittings with ornamental shades, bowl fittings for indirect lighting, and lanterns for shop lighting. There is also an up-to-date selection of electric radiators, electro-vapour radiators, fires, ovens, grills, hot plates, toasters, kettles, saucepans, irons, fans, water heaters, vacuum cleaners and electrically-heated clothes rails. Medical practitioners will be interested in an appliance for sterilising instruments, and dentists in a small electric motor, complete with attachments especially suitable for their mechanical work. Amongst the miscellaneous apparatus on view are electrically-heated glue pots, curling irons, soldering irons, shaving pots, &c.

Legal.—Lindsell *v.* Paignton Electric Light Co., Ltd.—On Tuesday, Mr. Justice Bailhache delivered his judgment in this case, which was heard on January 23rd, and reported in the Electrical Review for January 30th. The case raised the question whether electricity supplied to a kinema should be charged for as for power or as for lighting purposes. His Lordship allowed the appeal of the Supply Co., with costs, and Mr. Justice Bray concurred.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Liverpool Sub-Centre.—The Sub-Centre is to be congratulated on opening to the public its meeting on April 19th, when Dr. C. V. Drysdale will deliver the Kelvin Lecture on "Modern Marine Problems in War and Peace," at the University. The event is being announced by means of posters, of which we have received a copy from the hon. secretary, Mr. O. C. Waygood, and should prove very attractive to non-members, as well as to the members of the Sub-Centre.

Western Centre.—Mr. Arthur Ellis, chairman of the Centre, presided over a record attendance of members and visitors at the fifth meeting of the present session, held at the South Wales Institute of Engineers on April 11th. The reason for the crowded audience was the delivering of a popular lecture by Prof. F. Bacon, M.A. of the University of Cardiff, on "Thermionic Valves." After referring to some of the wonders achieved by the three-electrode valve during the war, and citing various instances to show that the Allies scored over the Central Powers by outstripping them in the application of valves for naval and military purposes, the lecturer confined himself to the two-electrode valve, paying special attention to present and prospective applications of interest to those engaged in heavy electrical engineering. The characteristics of high-tension rectification with hard valves, and low-tension rectification with gas-filled bulbs and mercury arc rectifiers, were discussed at some length. The combination of hard valve condenser, and voltmeter for reading peak voltages on tests of dielectric strength was also described and illustrated with oscillograms. The physics of hard and soft valves was dealt with in a popular manner, and illustrated by various lecture experiments in which striking use was made of the Tungar and Pointolite. The lecture was followed by demonstrations by Messrs. E Gordon Davies and F. D. Smith of a considerable variety of valves and valve apparatus kindly lent for the occasion by the Marconi-Osram Valve Co., Mr. S. R. Mullard, the Edison Swan Electric Co., the British Thomson-Houston Co., Mr. H. W. Sullivan, Dubilier Condenser Co., Power Rectifiers, Ltd., the Technical College (Cardiff), and the Physics Department, University College (Cardiff). A brief discussion followed the lecture, to which Captain Andrews, R.A.F., and Messrs. Ellis, Evans, Thomas, Chamen, jun., and C. T. Allan contributed. At the close a hearty vote of thanks was accorded Prof. Bacon for his most able and interesting lecture.

Junior Institution of Engineers.—At an informal meeting of the Institution, on April 9th, an extremely interesting lecture upon "The Development and Manufacture of Thermionic Valves" was given by Mr. A. H. Howe. The speaker commenced with a brief history of the evolution of the valve, in the course of which the principles were explained. By means of lantern slides the earlier types were illustrated, and then the various stages of improvement to the valves in present-day use were shown. The lecturer demonstrated the amplifying effects of the device by the use of three valves in cascade, and examples of many types were on view. Mr. Howe explained, as far as he was permitted, the mode of manufacture, and gave some remarkable indications of the uniformity with which thermionic valves can be produced by modern methods. The speaker referred to the use of valves by the Germans, who showed a preference for the "soft" types. Upon the conclusion of the lecture the speaker was subjected to a fire of questions, to all of which he ably replied. Many members of the audience, whose acquaintance with matters electrical was apparently not of a profound nature, evinced great interest in the discourse, but at least one gentleman did not get what he wanted. Upon entering and taking his seat he caught sight of some diagrams pinned upon a blackboard, and, turning to a friend, remarked, "I thought it was something to do with steam engines!" and he *may* have meant it.

The Institute of Metals.—The position of students whose course of studies was interrupted by the war, or by special circumstances arising from the war, has been sympathetically considered by the Council. It has been decided to recommend for ballot as Student Members of the Institute candidates for election who, whilst being students of metallurgy, have passed the age limit of 25 years. Students so elected may remain in the category of Student Members up to June 30th, 1923, so long as they continue to be students of a recognised school of metallurgy. This concession represents an appreciable financial saving, as a Student Member pays only the guinea entrance fee, and guinea subscription of pre-war days. Though in operation for only a few weeks past, the arrangement, we understand, has resulted in a greater number of applications being received at the offices of the Institute, 36, Victoria Street, S.W. 1, than was the case in the whole of 1919. By a further concession, members and students elected at the forthcoming ballot on May 31st, will not only have the privilege of membership for 13 months, instead of the usual 12, but will receive an extra copy of the "*Journal* of the Institute of Metals," of which important publication volumes to the value of over £1,000 have been sold to non-members during the past 12 months—surely a unique record for a young scientific society.

Wireless Society of London.—At a meeting of the Society on March 27th, a paper was read by Capt. L. A. T. Broadwood, entitled "Harmonics in Continuous Wave Transmissions." After the paper there was an interesting discussion, in which a number of members took part, and at the close of the meeting, Capt. Broadwood was accorded a hearty vote of thanks. The President, Mr. A. A. Campbell Swinton, occupied the chair, and the business of the meeting, in addition to the election of some 15 new members, included a discussion as to the advisability of the admission of ladies to membership and associate membership to the Wireless Society. Several members spoke in favour of ladies being admitted and, on a vote being taken, the meeting was found to be unanimous. A number of members had brought interesting pieces of apparatus, and these were described and afterwards viewed with great interest. Capt. Donnisthorp was able to show and explain to the audience his recently-patented invention, in the form of a pocket-book receiving apparatus, and Mr. Powell Rees exhibited the "Polaris" receivers, which are exceedingly compact pieces of apparatus.

Diesel Engine Users' Association.—At the March meeting, the subject of insurance of Diesel engines against breakdown was considered. Some years back the Association adopted a standard form of insurance policy at Lloyds, and, as a result of experience gained in the working of this scheme of insurance with periodical inspection by independent Diesel engine experts, it was considered advisable to amend the conditions of the policy in certain respects. The new form of policy adopted by the Association eliminates from its scope claims for cracks or partial fractures, which do not in themselves result in an actual "breakdown." It was considered that not only would this alteration have the effect of eliminating in future certain difficulties and causes for dispute, but that it would be an advantage from the point of view of securing the best Diesel engine practice to make such costs chargeable to the ordinary annual maintenance account. It was pointed out that the main advantages which the user should have in mind in insuring his Diesel engine against breakdown were in the first place to secure himself against heavy financial loss in the event of an actual breakdown with, or without, resulting damage to surrounding property, and, secondly, to secure the advantages of periodic inspection by independent experts and their advice and assistance in adopting the best practice, carrying out timely repairs, and in doing everything possible to avoid the calamity of a serious breakdown.

A paper on the subject of "Obturators" was read by Mr. W. Fennell. In pointing to the advantages claimed for the use of obturators in place of piston rings in petrol engines for aeroplane

work, the author referred to the actual power wasted in piston ring friction in many cases as being as much as 75 per cent. of the total mechanical loss in an engine. The obturator was described as a sort of "cup leather" made of thin metal. These were originally made of brass, but were now made of specially-selected phosphor bronze. They were usually placed very near the top of the piston yet they did not burn, and this was explained by their flexible nature which allowed them to keep in perfect contact with the cylinder, and consequently well cooled. The author had experimented with obturators in Diesel engines to a limited extent, and their life had been about 300 hours. Further tests were in progress, and he thought that a life of well over 1,000 hours could be expected with a new liner. With the successful use of obturators, instead of piston rings, the author considered that Diesel engine design might be considerably modified, resulting in reduced height and weight, and that this would facilitate the introduction of cross-head engines, as the question of thrust surfaces did not then come in.

Chelmsford Junior Society of Engineers.—This Society held its first annual dinner and smoking concert at the Lion and Lamb Hotel, Chelmsford, on the evening of March 31st. The President, Mr. T. E. Dann (of Messrs. Crompton & Co., Ltd.), was in the chair. The Vice-President, Mr. A. Eddington, and gentlemen who had delivered lectures during the session—Messrs. E. L. Barclay, H. Church, E. H. Field and W. C. C. Turner—were also present. The toast of "The King" was proposed by the President. Mr. E. H. Field, in proposing "The Society," said he knew the difficulties encountered in running such a Society, and thought they had done exceedingly well. In replying, Mr. A. Eddington said the Society had a membership of 43, and had held 14 meetings at which papers were read. Mr. T. Dann, also replying, said that the progress they had made by their own unaided efforts filled him with brightest hopes for the future. Mr. P. Huggins proposed the toast of "The Visitors," and Mr. H. Church replied. A smoking concert followed.

Edinburgh Electrical Society.—On April 7th the Society held an Apprentice Night. Papers on "Accumulators," "Cable Laying," and "Armature Winding" were read and discussed by apprentice members. At the next meeting, to be held on Wednesday, 21st inst., Mr. J. McEwan Brown will lecture on "The Telephone." All those interested are invited to be present at the Philosophical Institute at 8 p.m.

South African Institute of Electrical Engineers.—The *Journal* of this Institute for January, 1920, contains a report of the eleventh annual general meeting. The financial status was stated to be good—a sum of £1,500 having been accumulated and invested. The total membership increased to 355 during the year. Gold medals were awarded, to Prof. W. Buchanan for a paper entitled "The First Electric Steel Melting in South Africa," and to Mr. L. F. Botting for a paper on "Small Generating Stations and Electricity Supply Schemes." Mr. E. V. Perron was elected vice-president for 1920-21, and other members were elected to the Council. Mr. H. S. King gave an interesting lecture on "French Warfare," and a bioscope exhibition of various large constructional works concluded the meeting.

On February 19th, a paper on "Automatic Telephony" was read by Messrs. F. G. Parsons and C. Griffith, of the Post and Telegraph Engineering Department, dealing mainly with the Strowger and Western Electric systems. The authors indicated that it was intended to convert the city of Johannesburg to automatic working, up to a capacity of five figures, and ultimately to extend the system to the whole of the Reef.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The following officials of the Bradford Corporation electricity and tramways departments have been recommended for increases of salaries by the War Wages Committee as follows: Electricity department, city electrical engineer (Mr. T. Roles) to £1,500; chief electrical engineering assistant (Mr. J. Wright) £825; mains engineer (Mr. C. A. Gillin) £432; sub-station superintendent (Mr. R. D. Spurr) £392; technical assistant (Mr. J. F. Mather) £357; mains assistant (Mr. Q. Arbuckle) £332; the general manager (Mr. R. H. Wilkinson) to £1,000; traffic superintendent (Mr. T. Stirk) and assistant electrical engineer (Mr. J. W. Dawson) £535; parcels superintendent (Mr. W. K. Fleming) £410; works superintendent (Mr. S. Pearson) £385; permanent way engineer (Mr. J. W. Foster) £460.

It is stated that Mr. J. R. Lilleker, chief assistant and deputy electrical engineer of the Rotherham Corporation electricity works, has accepted a managerial position for a large manufacturing firm in the Midlands.

Mr. H. F. Marshall, who for five years past has been on the staff of the Barrow-in-Furness Corporation as electrical engineer, is about to take up an appointment in Shanghai.

We regret to hear that Mr. J. R. Groves, general manager of the Barrow-in-Furness Corporation tramways, is somewhat seriously ill as the result of a seizure while engaged in his office.

The chairman and deputy chairman of the Manchester Electricity Committee, with the chief electrical engineer, Mr. S. L. Pearce, are to visit certain cities in America in the autumn of this year to inquire into and report on the lay-out and interworking of modern extra-high-voltage transmission and distribution systems and the most modern practice with regard to the design and operation of large generation stations for economical production. This visit was approved by the Council in 1914, but was postponed owing to the war.

Mr. F. H. Rudd, electrical engineer for Rochdale, who was one of the selected candidates for the vacancy at Peterborough, has withdrawn his application for the post. The Rochdale Electricity Committee recommends a revision of his salary, and he is remaining.

Doncaster T.C. has appointed Mr. R. H. Nuttall, of Manchester, as tram-car shed superintendent, at £275 a year.

Torquay T.C. has appointed Mr. A. J. Waring, of Walsall, as mains engineer, at £250 a year.

Mr. J. M. Keenan, deputy engineer and manager of the Torquay Corporation electricity works, who is leaving to become engineer and manager to the Isle of Thanet Electrical Co., of Margate, has been presented by the staff and employés with a silver tea service.

York T.C. is recommended to increase the salary of Mr. Sheard, tramcar superintendent, from £258 to £275 a year, and that of Mr. Peterkin, draughtsman at the electricity works, from £270 to £294.

Accrington General Purposes Committee has decided to increase the salary of the electrical engineer by £150 a year and a further £50 next April; also that of the tramways manager in a similar manner.

Saturday, March 27th, was a great day in Marylebone when Prince Albert declared the new town hall open. The Mayor (Mr. Duncan Watson, M.I.E.E.) and the Mayoress welcomed the Prince and the Princess Alice, Countess of Athlone, and entertained them, as well as the Aldermen, Councillors, and other residents, to luncheon. Mr. Duncan Watson delivered several appropriate speeches. A very fully illustrated account of the day's proceedings will be found in the *Marylebone Chronicle* for April 2nd.

The marriage took place on April 5th at St. Nicholas Collegiate Church, Galway, of Mr. F. J. Moffett, B.A., M.I.E.E., of Birmingham, to Lucy Evelyn, second daughter of Mr. and Mrs. R. B. Smith, of Galway.

Mr. R. Baker-Whittick, A.M.Am.I.E.E., at present manager of Messrs. Waring & Gillow, Ltd., electrical contracts department, Liverpool (formerly of the sales staff, British Westinghouse, Trafford Park), has been appointed chief assistant engineer to Messrs. Edmundsons' Electricity Corporation, Inverness.

A coffee set was presented to Mr. W. A. Gillott upon the occasion of his leaving the Newcastle-upon-Tyne Electric Supply Co., Ltd., after fourteen years' service, to take up the position of sales engineer to the Jackson Electric Stove Co., Ltd., who have recently purchased premises at 143, Sloane Street, London, S.W. 1, which they will shortly occupy as offices and showrooms. For many years Mr. Gillott concentrated his energies upon the development of electric cooking and heating load, which now amounts to over 10,000 kw. on the N.E. Coast network. One of his immediate tasks is to establish and organise a selling department, and he is now compiling data for the publication of catalogues, &c.

On April 8th Mr. C. Wilson, managing director of the Osram-Robertson Lamp Works, was installed in the chair as Worshipful Master of the Hammersmith Masonic Lodge. The ceremony was ably carried out by Mr. G. G. Bell, installing master and borough electrical engineer. At the banquet which followed, the new Master was supported by approximately 170 brethren and visitors, including Grand Officers Sir Newton Moore (P.P.G.M. Western Australia), P. P. Kipping, P.Asst.G.S. Wks. R. C. Collins, H. Tipper, &c. There was an excellent musical programme. Sir Newton Moore responded to the toast of the Grand Officers.

Mr. J. A. Cressey, shift engineer, at Peterborough, has been appointed charge engineer at the Barnsley municipal electricity works.

Messrs. Charles P. Sparks & Partners have taken into partnership Capt. A. C. Sparks, M.C.

On the evening of April 1st, at a Bohemian concert held in the London United Tramways club-room, Fulwell Depôt, Mr. W. M. Wright, secretary of the S. Metropolitan Electric Tramways & Lighting Co., and assistant secretary of the L.U.T., was presented, on behalf of the staff, with a solid silver tea service, upon relinquishing his appointment after 21 years' service, to take up a position in the Provinces. Mr. J. B. Mackinnon, general traffic superintendent, made the presentation.

Mr. F. H. Newman, head of the Department of Physics, University College, Exeter, has been awarded a grant of £120 by the Royal Society in order to prosecute research on a new kind of electrolytic interrupter for X-ray work, which he exhibited before the Physical Society last November.

Will.—The *Times* states that the late Mr. Claud Hamilton, managing director of Claud Hamilton, Ltd., engineers, Glasgow, Aberdeen, Ardrossan and Ayr, left personal estate of the value of £203,491.

NEW COMPANIES REGISTERED.

Hotpoint Electric Appliance Co., Ltd. (165,887).—Private company. Registered March 30th. Capital, £100,000 in £1 shares. To carry on the business of manufacturers and importers of and dealers in domestic, industrial and labour-saving devices and electrical appliances, engineers, &c. The subscribers (each with one share) are: H. C. Levis, 83, Cannon Street, E.C.4, managing director British Thomson-Houston Co., Ltd.; A. R. Monks, 123, Cannon Street, E.C.4, solicitor. The first directors are: H. C. Levis, W. C. Lusk and J. Gray. Secretary: F. Clements. Registered office: 83, Cannon Street, E.C.

Franklin Engineering Co., Ltd. (166,122).—Registered April 7th. Capital, £50,000 in £1 shares. To take over (1) the business of an electrical, mechanical and motor engineer carried on by W. H. Franklin at Tunnel Works, Queen Street, Cardiff; and (2) the business of a bioscope and scientific instrument maker carried on by T. W. Franklin at 6, North Edward Street, Cardiff, as the Western Instrument Co. The first directors are: P. Evans, Holme Tower, Penarth, shipowner; H. G. D. Cory, Mount Stuart House, Cardiff, shipowner; F. O. Cory, Padstow, Whitchurch, Glam., shipowner; R. E. Duck, Rhosslyn, Heath Park Avenue, Cardiff, engineer; W. H. Franklin, 69, Mardy Street, Cardiff, engineer; T. W. Franklin, 6, North Edward Street, Cardiff, electrical engineer. Secretary: A. D. Jones. Registered office: 233, Cowbridge Road, Cardiff.

Aurolite Electrical Supplies, Ltd. (165,924).—Private company. Registered March 31st. Capital, £3,000 in £1 shares. To manufacture and deal in apparatus and appliances for use in connection with electricity or gas for light, heat or power, &c. The first directors are: J. A. Ward, Westness, Sutton, Surrey; A. S. Gregg, 19, Clifford Road, East Finchley, N.2; J. F. Atkinson, 58, Elgin Crescent, North Kensington, W. Solicitor: A. Glynne-Jones. Registered office: Cromwell House, Surrey Street, Strand, W.C.

Lumo, Ltd. (165,967).—Private company. Registered March 31st. Capital, £8,000 in £1 shares. To take over the business of a manufacturing chemist carried on by J. H. Piddock at 79, Lincoln's Inn, Corporation Street, Birmingham, as "J. H. Piddock & Co.," to carry on the same and the business of manufacturers of and dealers in the compound known as "Lumo Washeasy," manufacturers of and dealers in electrical appliances and labour-saving devices, &c. The subscribers (each with one share) are: D. G. Brooks, 88, College Road, Moseley, Birmingham, electrical engineer and merchant; G. C. Gray, 17, Oval Road, Gravelly Hill, Birmingham, electrical engineer. First directors not named. Solicitor: D. Cochrane, 55, Temple Row, Birmingham. Registered office: 79, Lincoln's Inn, Corporation Street, Birmingham.

Magic Sign Co., Ltd. (166,106).—Private company. Registered April 7th. Capital, £1,000 in £1 shares. To acquire from F. S. Gee the benefit of certain inventions relating to display devices, and to carry on the business of manufacturers of and dealers in advertising apparatus, plant and material, &c. The first directors are: F. S. Gee, 23, Compton Crescent, Chiswick, W.4; W. A. Dunn, 76, Amhurst Park, N.15. Solicitors: Strong and Bolden, 70, Gracechurch Street, E.C. Registered office: 13, Gate Street, Kingsway, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Keighley Electrical Engineering Co., Ltd.—Capital, £10,000 in £1 shares (3,000 preference). Return dated November 12th, 1919. 4,200 ordinary and 1,800 preference shares taken up. £3,988 paid. £2,012 considered as paid. Mortgages and charges, £5,000.

Cross & Cross, Ltd. (105,754).—Capital, £5,000 in £1 shares. Return dated February 23rd, 1920. All shares taken up. £4,845 paid. £155 considered as paid. Mortgages and charges, £600. Capital increased to £20,000 in £1 shares on March 10th, 1920.

Secar, Scott & Co., Ltd.—Particulars of £1,000 debentures authorised November 26th, 1919. The whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees. Mortgage dated March 22nd, 1920, to secure £640, also registered. Property charged: 49-55, St. Peter's Street, Coventry. Holder: C. Pace, 125, Brighton Road, Croydon.

Dood & Oulton, Ltd.—Satisfaction in full on March 24th, 1920, of debentures, dated July 1st, and October 5th, 1908, securing £5,000.

Switchgear & Cowans, Ltd.—Satisfaction in full on March 18th, 1920, of debentures dated October 27th, 1911, and June 4th, 1912, securing £3,500. Issue on June 4th, 1920, of £800 debentures, part of a series.

Frank Towey & Co., Ltd.—Mortgage dated March 20th, 1920, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd., charged on certain land and premises in Birmingham.

CITY NOTES.

W. T. Henley's Telegraph Works Co., Ltd.

Mr. George Sutton presided at the annual meeting held on April 9th. He said that on the debit side of the balance sheet the item of creditors and contingent reserves and reserve for special taxation showed an increase of about £148,000 over last year. That was caused to some extent by the reserve for special taxation. If the directors' proposals were adopted the reserve account would be brought up to the substantial sum of £150,000, so it would be seen that they did not anything like exhaust their reserves when they made the distribution of bonus shares. Last year he told them that they would be spending very large sums on buildings and plant, but the buildings contracted for in the early part of last summer were still very far from complete owing to labour and other difficulties. Probably some time this year they might have the new buildings earning revenue. Stock-in-trade had increased from £229,000 to £457,000. That was what they would expect from the higher prices, coupled with the fact that they were now able to make stock, which they could not do twelve months ago. Really they had about doubled their stock. The debtors were £40,000 more than in the previous year, and the cash at bankers was £118,000, as against £213,000 in the year before. Turning to the profit and loss account there was a curious similarity, the figures of the trading account differing from those of the previous year by only a few pounds. Last year the account was not subjected to as large an amount for excess profits duty as in the previous year, as the duty was reduced 40 per cent. last year. On the other side, they had written off £25,000 for depreciation on machinery, &c. The previous year they wrote off £35,000, but that was largely to deal with machinery and plant which had been acquired for the purposes of the war, and £25,000 they had written off this year was quite a large and ample sum. They were carrying forward to the profit and loss account £20,000 more than in the previous year, and after paying the dividends proposed they would carry forward £141,000 as against £122,000 brought into the account. The accounts gave them the same healthy and robust state of things which they had been accustomed to in connection with the company for many years past. They had had more orders during the past year than they had been able to carry out—that referred both to the overseas and the home trade. Although they recognised the value and the need for export trade, they had considered that the policy of the company should always be to satisfy the needs of their customers in the home trade first. They had not been able to satisfy even all their needs, although on the whole they had done very well for them. They were always behind with their orders owing to the delay in getting raw material, &c., and output had been restricted by the shortened hours of labour. He was not complaining of their workpeople in any way, but they had not got back to the output that they had before the hours were shortened. They were now working a 47 hour week as against 54. He was glad to say that their relations with their workpeople had continued to be very satisfactory. They had had no trouble during the year. The Cable Makers' Association, in conjunction with the trade unions who were interested in the people working in their factories, had established a Whitley Council, which met once a month. District Councils met more frequently, and they had had no serious differences of opinion. The Council worked very well, and he was hopeful that in the future they would be outside the turmoil that seemed to be going on with labour in many industries. As in the past year there had been an abundance of work, so in the immediate future they did not doubt that they could get more work than they wanted. Trading to-day, however, was very different to what it was in 1914, the year before the war. In some respects, such as higher rates of wages, it might be that the present rates might be considered the minimum for the future, but in regard to taxation he believed it was essential for the success of industry that direct taxation, such as the excess profits duty, should not be put upon them. In 1914, and perhaps for 20 or 25 years prior to that time, the company was subjected to taxation of about £12,000 a year. In 1919 the taxation amounted to £100,000, and that was considerably below the average taxation for the war years. They had paid for excess profits duty the huge sum of roundly £400,000. On the other hand, the dividends paid to the shareholders, prior to the war, in 1914 was £49,000, and the dividend to-day absorbed £69,000. Hitherto the company's business had relief for its extension upon its undivided profits, and the course they had adopted had been a benefit to the nation, to the company, and to those who worked for it. It might be said that they had done what they had for their own advantage, but if they took away that advantage by a severe limitation of profit, the nation, the company, the capitalist and the workman would all be the poorer. There had been an enormous demand for capital for industrial purposes since the war, and about 150 millions had been asked for since January 1st. They would naturally expect that they would want more capital in that company. The increase of profits shown in recent years did not give an accurate idea of the amount of business they had been doing. The profits tended to decrease year by year as the percentage of the turnover of the business increased. Their percentage of profits was not so great now as it was five or ten years ago, but the business itself had greatly increased, not only in value but also in quantity. He thought they would agree that that was a very healthy state of things which they would not desire to see altered, but it brought with it the need for more capital. As he had said, it had been their custom for a good many years to find the capital for the extension of the business out of their undivided profits, but at the present time that source was to a very great extent closed. They had large expenditure coming on in the immediate future—they had commitments for buildings and plant which roundly came to £150,000. On the credit side of the balance sheet they showed that they had in war loans and other securities and cash a sum of about half a million sterling. Some of that, however, had to go away in taxation. He thought it was very likely they might be able to get along without asking the shareholders for more capital. The business was showing abounding prosperity. The orders brought forward from the past year, added to those taken this year, actually exceeded the whole of last year's turnover. That all had a direct bearing upon the capital requirements of the company, and they also had the tire company to consider. They had put nearly £200,000 into that company, and the justification for it was the success which

the company had attained. They knew that Henleys had been very successful in their trading with electric cables for the last 35 years, but there was no success which had been so quickly acquired as the success which they had attained in the manufacture of pneumatic and solid tires. The establishment of the tire company was a good thing for them, but it would require more capital. They could not stand still, and they were extending the factory. Everything pointed to their wanting new capital, but he felt that if they should want more money they could call the necessary meetings and raise all the capital they would require in the course of a few weeks. For that reason the directors had decided not to deal with the question then, for it might be that they would be able to do without any new capital. A resolution was agreed to authorising the directors to apply out of the funds of the company a further £5,000 for the benefit of the staff pension and deferred pay funds.

The Allmanna Svenska Elektriska A.B.

The report of the directors of the Allmanna Svenska Elektriska A.B. (General Swedish Electrical Co.), of Vasteras, has just been issued for 1919, which is the 37th year of the company's existence. The report states that activity during the year was characterised by the transition from war to peace conditions, but the effects of the war were still far from being overcome, and some years would probably elapse before the industry was again brought into a state of equilibrium. The prices of materials fluctuated rapidly, and the cost of labour showed a constant tendency to increase, this being contributed towards by the reduction in the working shift and the unrest in the labour market. The result of last year's working was influenced to a not inconsiderable degree by the falling prices of materials and the growth in working expenses, although the prices of the company's manufactures were increasing. As a result of the absorption of Surahammars Works A.B. and the Nya Forenade Elektriska A.B., the central management had been reorganised so as to secure increased efficiency for the different departments and clearly definite responsibility. During the year the company's liquidity was considerably improved, partly on account of the release of the capital tied up in goods which was rendered possible by the resumption of free communication after the cessation of the world war, and partly through the funds derived from the new issue which was carried out in 1919. The amount of the disposition fund which was not required for covering the taxes for the years 1916 and 1917 had been transferred to the reserve fund.

The activity of the department for electrical installations proceeded on normal lines; the high cost of coal hastened the use of water powers, and rendered possible the utilisation also of waterfalls which were formerly considered to be uneconomical for the purpose. In the case of agriculture electrification was being continued, whilst the long-pending question of the conversion of the railways to electrical working was rapidly approaching a solution, and considerable orders in this branch were received from Scandinavian countries during the year. The export of electrical machinery was resumed in July. New markets had been obtained in the West of Europe, but trade with the East of Europe continued at a standstill. The exports, however, were rendered difficult by the prevailing conditions of exchange and the need of a stabilised currency system was all the more perceptible. After referring to the iron and steel and other departments, the report mentions that the total staff and workmen numbered 7,220 at the end of the year, and that the profit sharing system approved a year ago for leading members of the staff was now in operation. The expenses for the welfare arrangements had declined and were expected to be further reduced in the near future.

After writing off 1,338,000 kr. for depreciation, as compared with 1,280,000 kr. in 1918, the accounts show net profits and balance forward amounting to 8,313,000 kr., as against 7,799,000 kr. in 1918 and 16,610,000 kr. in 1917. It is proposed to pay a dividend of 10 per cent. on share capital of 75,000,000 kr., this contrasting with 15 per cent. on 50,000,000 kr. in 1918, leaving 818,000 kr. to be carried forward. The turnover last year experienced a decrease of 5,000,000 kr., but the company's debts were reduced by 26,000,000 kr.

German Companies.

The directors of the *Lloyd Dynamo Werke A.G., of Bremen*, recommend the payment of a dividend of 7 per cent. for 1919, being the same rate as in the previous year.

The *Elektrizitats Lieferungs Gesellschaft, of Berlin*, proposes to pay 12 per cent. out of net profits of 3,950,000 marks in 1919, as contrasted with 10 per cent. and 3,274,000 marks respectively in 1918.

The *Welter, Elektrizitats und Hebezeug Werke, A.G., of Cologne-Zollstock*, reports net profits of 135,000 marks for 1919, as against 84,000 marks in the preceding year. It is intended to distribute 10 per cent., as compared with 8 per cent. in 1918.

The directors of the *Hochfrequenz Maschinen, A.G., fur Drahtlose Telegraphie, of Berlin*, recommend for 1919 a dividend and bonus of 35 per cent. on the "A" shares, as compared with 20½ per cent. in 1918, and 92.8 per cent. on the "B" shares, as against 49.1 per cent. in the preceding year. The net profits are returned at 1,897,000 marks, as contrasted with 588,000 marks in 1918.

The net profits of the *Sachsenwerk Licht und Kraft, A.G., of Dresden-Niedersedlitz*, increased from 1,930,000 marks in 1918 to 2,240,000 marks last year. It is proposed to pay a dividend of 20 per cent. for 1919, being the same rate as in 1918, when less share capital participated in the distribution. An abundance of orders at adequate prices is reported for the present year, but expenses have increased and raw materials are difficult to obtain.

The *Ges. fur Elektrische Hoch und Untergrundbah, of Berlin*, reports net profits of 1,542,000 marks for 1919, as compared with 4,050,000 marks in the previous year, and a dividend at the rate of 5½ per cent. is recommended, being the same rate as in 1918. It is stated that the price of coal, which cost the company 16 marks per ton before the war and 81 marks in 1919, is now over 250 marks per ton.

The directors of *Siemens Elektrische Betriebe, A.G., of Berlin*, report gross profits of 4,230,000 marks from electricity supply works and investments in 1919, as compared with 3,730,000 marks in the previous year. After making provision for depreciation it is necessary to place 2,360,000 to reserve in order to equalise differences in exchange, so that there only remain net profits of 67,000 marks, as against 1,970,000 marks in 1918, when a dividend at the rate of 5 per cent. was paid. The balance for 1919 has been carried forward.

Vickers, Ltd.—The directors announce that, owing to the immense volume of work executed for the Government during the war years—much of which, due to extreme urgency, had to be undertaken by the company without prices being fixed—there are Government contracts yet remaining unsettled, some reaching back as far as 1916. It is still, therefore, not possible to present the accounts for 1916, or any of the subsequent years. The final accounts up to the end of 1919 may be presented before the end of the current year. Considering the necessity for preserving and increasing the financial strength of the company while changing over from war to peace products, the directors have decided to declare a final dividend for 1919 of 1s. 3d. per share, or 6¼ per cent. (free of income tax up to 5s.). This, together with the interim dividend declared in August, 1919, will make a total dividend for the year of 2s. 3d. per share, or 11¼ per cent. (free of tax up to 5s.). The main works of the company, and of the companies associated with it, are well filled with orders.

Madras Electric Tramways (1904), Ltd.—Mr. A. M. Quill presided on April 7th at the annual meeting. He said that the Mount Road extension was commenced immediately after the Government Order was issued last July. Good progress had been made with the permanent way, but in consequence of labour troubles at home considerable delay had taken place in the shipment of poles and other materials, and some time would elapse before the extension could be opened for traffic. When the line was completed important extensions of the system would become practicable, but progress with these would depend upon a substantial reduction in the prices of tramway materials, of which there was no indication at present. After referring to the improvement in the traffic receipts (9 per cent.), and to the demands of the employés for higher wages to meet the cost of living, the chairman said that they were considering the advisability of applying to Government for authority to increase the fares authorised by their Government Orders.

Stock Exchange Notices.—The committee has ordered the undermentioned to be officially quoted:—

Brompton & Kensington Electricity Supply Co., Ltd.—166 ordinary shares of £5 each, fully paid, Nos. 34,085 to 34,250.

Pennsylvania Water & Power Co.—$2,154,000 first mortgage sinking fund 5 per cent. gold bonds, 1940, of $1,000 each, within Nos. 8,506 to 10,940.

British Electric Transformer Co., Ltd.—The accounts for 1919 show that after paying all manufacturing costs and expenses of administration the net profit is £48,038, plus £3,964 brought forward. There is put to reserve £10,000, to depreciation reserve £3,000; 6 per cent. preference dividend £8,407; 10 per cent. on the ordinary shares, and bonus of 2½ per cent. £17,550; extra remuneration to directors £2,522; carried forward £10,523.

Monte Video Telephone Co., Ltd.—Interim dividend on the ordinary shares for the half-year at the rate of 6 per cent. per annum, free of tax.

Indo-European Telegraph Co., Ltd.—Final dividend of 22s. 6d. per share, making 7 per cent., free of tax, for 1919; also distribution out of the equalisation of dividends fund of 15s. per share, free of tax, making 10 per cent. for the year.

Northern Electric Co. (Montreal).—Dividend 3½ per cent. for 1919. Foreign exchange situation a very serious factor, costing the company $252,472 for the year.

Consolidated Electrical Co., Ltd.—Dividend on the ordinary shares for the year ended March, 1920, 3½ per cent., against 2½ per cent. for the previous year. Carried forward £1,685.

Electrical Utilities Corporation, Ltd.—Quarterly dividend of 1¼ per cent. on the preferred stock.

Shawinigan Water & Power Co.—Net revenue for 1919 $1,473,743, as compared with $1,410,093. To depreciation reserve $300,000. Dividends 7 per cent.

Bell Telephone Co. of Canada.—Quarterly dividend of 2 per cent., less tax.

STOCKS AND SHARES.

Tuesday Evening.

There is nothing very much to be said this week for the consolation of the investor. It would be indeed amazing were Stock Exchange markets to exhibit any particular degree of strength, having regard to the forces arrayed against confidence and hopefulness. The Budget and the French exchange, the trouble on the Continent, and the renewed labour restlessness at home, the stream of new issues and the possibility of a rise in the Bank Rate—it would be hard to imagine any fresh element that might make things worse than this combination of adverse conditions. To put money on deposit at some modest rate and leave it there until the air clears—this is the course advocated by many people nowadays, and one which they are apparently following, if the quietude of business in Stock Exchange markets may be taken as a trustworthy guide. The flatness of Monday was compensated by partial recoveries on Tuesday, when the Anglo-French rift looked less threatening, and perhaps prices may pick up after the Budget provisions are officially announced.

The demand of another £1 per week by the railwaymen is the more serious from the inference it holds of agreements between employers and employed being held of no value by the latter when they want to vary the terms. Sanctity of contract is deemed to lie at the base of all business, in this country at any rate, and if that goes, what can be substituted in its place? A rise in railwaymen's wages of £1 a week would introduce further advances in the cost of living and fresh demands for more pay on every hand. It is inevitable that money should shun shares in companies where profit-earning capacity is liable to be interfered with a month after a threatened strike is settled by agreements signed for a year or more.

Underground income bonds are 2 lower at 72, and Metropolitans ¼ down at 21, but Districts rose to 19. Other traction issues are easier. Bombay Electric preference have come down 25s. to 17¼. The ordinary shares, after their meteoric spurt, are quoted lower at 130 middle, with business done the other day at 125. Mexicans are flat. The Light and Power Common and preferred have both shed 5 points, and the bonds lost 2¼. Mexico Tramways Sixes are marked down to 24, and changed hands at 23¼. Other Mexican utilities have moved similarly. British Columbia Electric Railway preferred, after a drop to 46¼, rallied to 49½, which makes the yield work out to over 10 per cent. on the payment of 5 per cent. dividend. Brazilian Tractions remain at 50. A timid inquiry for London and Suburbans—on the fare-raising proposals—failed to advance prices of the shares.

In view of the changed circumstances of the times, a few companies have already raised the dividends on their preference shares. Obviously it presses harshly upon investors in senior issues, that they should be obliged to take a modest 5 per cent., or thereabouts, on money they have furnished to a company in bygone days, when to-day's appeals, even from that same undertaking, may offer 7½ or more per cent. on security practically identical. There is so much to be said, on both sides of the subject, that it cannot be more than mentioned in a paragraphic manner, but the question is closely occupying the attention of many directorial boards at present.

Electricity Supply shares show a few mixed movements. County ordinary, Charing Cross ordinary, and South Metropolitan preference are firmer. City Lights and Westminsters are both ¼ down. Business is meagre, as usual at this season of the year. Nor do manufacturing shares display any particular activity. British Aluminium at 25s. 7½d. are ex rights, and so are India-Rubber shares at 13¾. On the latter, the premium varied between sixpence and a florin. Metropolitan-Vickers preference went back to 2⅝, and Vickers fell to 31s. 3d. on disappointment with the dividend, though subsequently the price rallied to 32s. 6d. General Electrics and Siemens are easier. Cromptons at 22s. have gained sixpence. Edisons remain about 22¼.

Thursday in this week was the last day for sending in applications for the new issue of shares by the four big cable companies in the Eastern group. The prices kept up strongly to the finish. This served to harden the existing securities. Eastern ordinary is up 3. Globes and Westerns are both 5s. higher, joining Westerns at the common level of 15s. 4d. At this price the yield comes to a little over 6¼ per cent. on the money, equivalent to 9¼ per cent., less tax, at 6s. in the pound. Marconis rose to 4, reacted to 3¾, and recovered to 3¼. It is said that the idea has been revived, and is likely to be put into execution, of proceeding with the wireless-chain project that was interrupted by the outbreak of war. Indo-Europeans are at present unchanged on a reduction of 3 per cent.—to 10 per cent.—in the dividend.

It may perhaps—diffidence urges a little dubiety—be of some slight interest to remark that this particular article on stocks and shares has just attained its majority. In twenty-one years there have appeared 1,092 articles, and without any special count having been kept of the number, it is fair to say that well over a thousand of these have been penned by the same hand. The scope of financial interest in stocks and shares connected with the electrical industry has widened enormously during the period. If there be one thing more than another that stands out as a special feature, it is the way in which individual finance is gradually being replaced by a condition of affairs in which internationalism is the prime factor. The Paris exchange is rocky and Brazilian Tractions feel its effect. A strike in America is reflected in shares of manufacturing companies over here, and so on. It would be more beguiling to the writer than to his indulgent reader to dwell at length upon other striking aspects of financial affairs connected with the electrical world during the past twenty-one years. But the temptation shall be avoided. Nor is it altogether certain that Editorial censorship will allow to be printed a little expression of gratitude to those who have followed these Stock Exchange letters week by week.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price April 13, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6½	—	£9 4 8
Charing Cross Ordinary	4	7	8¾	+ ¼	9 0 8
do. do. do 4½ Pref.	4½	4½	2¾	—	8 8 8
Chelsea	3	4	8	—	6 3 4
City of London	8	10	13	— ¼	7 13 10
do. do. 6 per cent. Pref.	6	6	9½	—	6 9 8
County of London	7	8	9½	+ ¼	8 13 10
do do. 6 per cent. Pref.	6	6	8½	—	6 17 2
Kensington Ordinary	6	7	5	—	7 0 0
London Electric	Nil	2½	13	—	5 2 6
do. do. 6 per cent. Pref.	6	6	8½	—	9 4 8
Metropolitan	5	6	36	—	8 5 6
do. 4½ per cent. Pref.	4½	4½	2½	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	8 16 10
South London	5	6	22	—	7 12 8
South Metropolitan Pref.	7	7	11/-	+6d.	7 0 0
Westminster Ordinary	8	10	5⅝	— ¼	8 17 10
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	83½	— 3	7 3 9
do. Def.	20/6	1¼	18½	— ¼	9 0 0
Chile Telephone	5	6	5¼	—	*1 13 2
Cuba Sub. Ord.	7	7	10	—	*7 0 0
Eastern Extension	8	10	13½	—	*6 10 1
Eastern Tel. Ord.	8	10	157½	+3	*6 7 0
Globe Tel. and T. Ord.	8	10	15½	+ ¼	*6 11 2
do. do. Pref.	6	6	9½	— ¼	6 9 9
Great Northern Tel.	22	—	22½	—	9 15 6
Indo-European	13	10	48½	—	5 8 1
Marconi	25	—	3¼	+ ¼	6 8 10
Oriental Telephone Ord.	10	—	9	+ 1/16	3 11 4
United R. Plate Tel.	8	—	7¾	—	*5 8 8
West India and Panama	1/8	—	1 1/16	—	5 10 0
Western Telegraph	8	10	15½	+ ¼	*6 11 2
Home Rails.					
Central London Ord. Assented	4	4	47½	—	8 8 6
Metropolitan	1	1½	21	— ¼	5 19 1
do. District	Nil	Nil	19	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	9½	— ¼	Nil
do. do. "A"	Nil	Nil	7/-	—	Nil
do. do. Income	5	4	72	— 2	5 11 1
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	82	—	—
do. do. 2nd Pref.	—	—	24	—	—
do. do. 5 Deb.	5	5	65½	—	7 15 0
Brazil Tractions	—	—	50	—	—
Bombay Electric Pref.	6	6	17½	— 1½	3 8 7
British Columbia Elec. Ry. Pfds.	5	5	50½	—	8 5 4
do. do. Preferrred	9½	5	49½	— 1	10 10 6
do. do. Deferred	Nil	3	42½	—	7 1 2
do. do. Deb.	4½	4½	66½	— 1	7 10 5
Mexico Trams 5 per cent. Bonds	Nil	Nil	24½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	24	+2	Nil
Mexican Light Common	Nil	Nil	13½	— 5	Nil
do. Pref.	Nil	Nil	22½	— 5	Nil
do. 1st Bonds	Nil	Nil	44	— 2½	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	3¾	—	*4 16 2
British Aluminium Ord.	10	10	1 7/16 xd	—	7 16 0
British Insulated Ord.	12½	15	1 1/16	—	7 14 6
Callenders	25	—	2⅜	—	7 5 10
6½ Pref.	6½	6½	1⅞	—	6 16 10
Castner Kellner	20	—	4	—	—
Crompton Ord.	10	—	22/-	+6d.	9 1 10
Edison-Swan, "A"	10	—	1¼	—	8 17 10
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	23/-	—	8 13 10
Gen. Elec. Pref.	6¼	6¼	19/6	—	7 0 6
do. Ord.	10	—	1⅞	— 1/16	*5 14 4
Henley	25	15	3¾	—	6 6 4
do. 4½ Pref.	4½	4½	2¾	—	6 4 2
India-Rubber	10	—	13¾ xd	—	*7 5 2
Met.-Vickers Pref.	—	8	32½	— ½	6 2 0
Siemens Ord.	10	10	22/-	— 6d.	*7 2 10
Telegraph Con.	20	20	94½	— 1	*4 18 0

* Dividends paid free of Income Tax.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Kingsway" Telephone Bracket.

Desk telephones are easily knocked over and broken, and are seldom found in a convenient position when required in the rush of business. The General Electric Co., Ltd., of 67, Queen Victoria Street, E.C. 4, has recently put on the market a new form of bracket for dealing with this inconvenience, the "Kingsway," fig. 1. This device has an extension of 30 in., the instrument is firmly gripped by one end of the bracket, while several types of base can be supplied to enable the bracket to be fixed to a wall or to the side or top of a desk. It is self-balancing and free to move in any direction, having a special motion giving height adjustment and being swivelled at the base. The "Kingsway" telephone bracket is well finished in oxidised copper.

Fig. 1.—The "Kingsway" Telephone Bracket.

A Portable Wireless Receiver.

The following is a brief description of the portable receiver used in a demonstration by Mr. R. C. Clinker, of the British Thomson-Houston Co., Ltd., 83, Cannon Street, E.C.4, at a meeting of the Wireless Society of London on January 29th last. This set, which measures 13 in. by 14 in. by 5 in., is completely self-contained, and comprises within its case a receiving coil, tuning condenser, two B.T.H. valves, accumulator, dry battery, transformers, and a reaction coil. The receiving coil is wound upon a frame which fits inside the outer case with a small air space between coil and case. Inside the receiving coil is placed all the apparatus enumerated above. The cover is fitted with "lift-off" hinges, and has fixed on its inside face a projecting pin surrounding which is a large circular scale marked with the points of the compass, fig. 2. The case has a co-operating socket led into its base which allows of the whole set being placed on the pivot and turned easily on a vertical axis, fig. 3, so that the line of direction in which the received signals are travelling can be found. A small compass card fixed to the cover enables the latter to be placed approximately correctly relatively to the points of the compass. These details are seen in the illustrations, figs. 2 and 3. The connections of the set are such that the first valve is used as a detector, and the second as a low-frequency amplifier. A hinged reaction coil is provided which is connected in the "plate" circuit of the first valve and the coupling of which to the receiving coil may be varied by adjustment of its angular position. At a certain closeness of coupling the detecting valve commences to oscillate at a frequency depending upon the inductance of the receiving coil and the capacity of the condenser connected across it. When signals are to be received, whether from spark or continuous-wave stations, the condenser is set to give the correct wave-length, and the reaction coil is closed in until oscillation commences, when the signals are heard. Spark stations also are thus "heterodyned," and their true notes are modified, but can be read clearly. The set can be provided with sufficient capacity to tune between the limits of 2,000 and 15,000 metres wave-length, so that Paris time signals can be taken, and long wave stations such as Carnarvon and Lyons read. In all,

Fig. 3.—Wireless Receiver Mounted on a Pivot, with Telephone Connected Ready for Use.

about a dozen of the largest stations in England, France, and Germany may be read, and several more heard, without any additional wire. The signals obtained thus, while not, of course, loud, are clearly readable in a reasonably quiet room. To obtain the direction from which signals are coming, the case is rotated on its pivot, fig. 3, until the signals sink to a minimum or become inaudible. A pointer then indicates on the scale the direction, or one 180 deg. removed from it. The accumulator is of an "unspillable" type, and can be sent out with the set, ready charged for immediate use. A plug switch is provided for lighting the valve filaments, the handle of the plug being of such length as to prevent the case from closing if the filaments have been left alight. The weight of the complete set is 20 lb., and it requires no aerials; it should, therefore, be of interest to technical colleges, large works, watchmakers, &c., desiring to secure the correct Greenwich mean time daily.

Wiring Connector Box.

Messrs. Ward & Goldstone, Ltd., Sampson Works, Salford, Manchester, manufacture the connector box shown in fig. 4, which can be employed for practically any wiring system. It can be used as a 2 or 3-way joint box and a number of wires can be taken off each of the contacts. The box is of porcelain, the cover being fixed by means of penetrating studs and external nuts. The terminals are of substantial construction, and able to carry a current up to 25 amps. Wires can be introduced through either the base or top of the box.

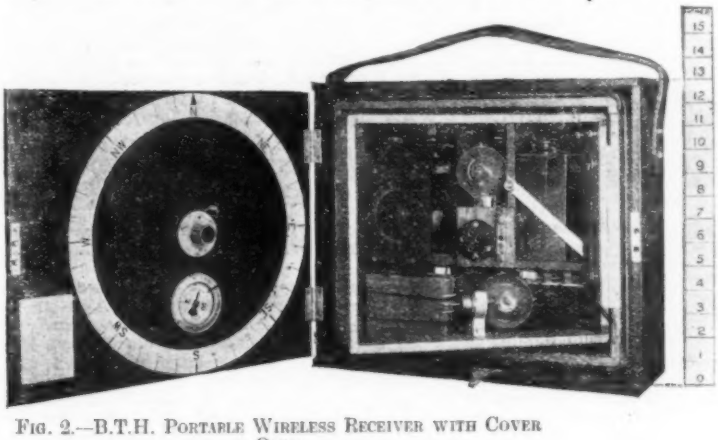


Fig. 2.—B.T.H. Portable Wireless Receiver with Cover Open.

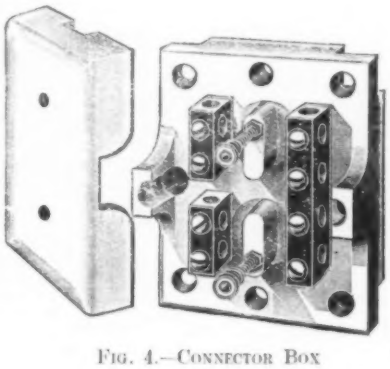


Fig. 4.—Connector Box

Reyrolle Telephone Terminal Box.

A new type of telephone dividing and sealing box has recently been designed and produced by Messrs. A. Reyrolle and Co., of Hebburn-on-Tyne. This box (fig. 5) has been specially designed for use in power stations, and the arrangement of terminals with ample space between them simplifies

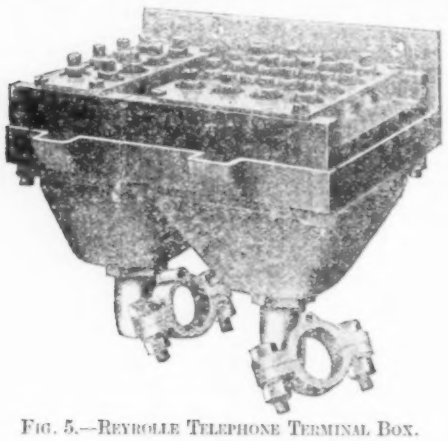


Fig. 5.—Reyrolle Telephone Terminal Box.

the making of connections and at the same time eliminates the danger of short circuits. The cables are brought into the box through screwed wiping glands, and armouring clamps are supplied. A plain sheet-iron cover protects the terminals from dirt and dust.

The Lodge Igniter.

At the recent Motor Boat Exhibition, at Olympia, Messrs. Lodge Bros. & Co., of Rugby, exhibited several types of igniter for use on both motor car engines and large gas engines. The Lodge igniter is used in precisely the same way as an ordinary single-trembler coil, with the usual battery and spark plugs. A H.T. distributing device on the camshaft is required for use with the igniter on all 4- and 6-cylinder engines. The coil is the special feature of the Lodge system of ignition. The essential difference between this and ordinary H.T. coil ignition is the presence within the former of special glass condensers or Leyden jars. These jars store up H.T. current induced by the secondary winding of the coil, and at the required moment release the whole of their contents across the sparking plug points with an impulsive rush of stored-up energy in the form of a high-frequency electric discharge, oscillatory in character, and of high velocity and heat. The Lodge spark is entirely different in character to the ordinary H.T. spark as produced either by coil or magneto; it is an explosive white-hot spark of great brightness and intensity. Instead of passing quietly through any deposits on the spark gap, the spark, it is claimed, blows all accumulations away, and actually keeps

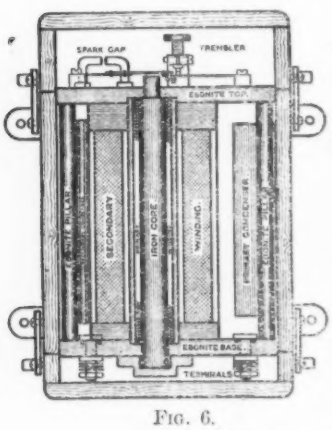


Fig. 6.

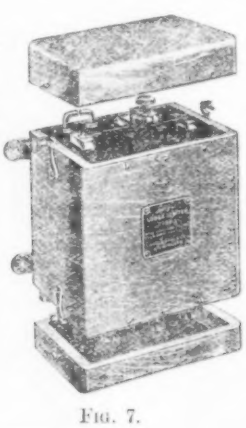


Fig. 7.

The Lodge Igniter.

the gap clear for itself. The spark from an ordinary coil or magneto is a steady flow of current in one direction, which passes quietly and easily. The Lodge spark is an oscillatory high frequency current, momentarily of large capacity. It is, in fact, a Leyden jar discharge, which surges backwards and forwards across the plug points.

In the Lodge igniter the terminals of the coil are not connected to the sparking plug directly as usual, but are led to it through the intervention of a pair of coated insulators, or Leyden jars, with their outer coatings short-circuited by a leak or imperfect conductor, the object of which is to keep them always at the same potential except at the instant of a sudden electric rush. Accordingly there is no strain thrown upon the leads or the sparking plug, whose terminals remain at the same potential up to the last moment when the two jars are full and overflow, at which instant everything is liberated, and with a rush the jars empty themselves across the spark gap and round the complete circuit through the sparking plug.

The chief pattern at present in use for motor-car purposes is the type A, illustrated in fig. 7 and in section in fig. 6.

The trembler will give very accurate timing even at the highest speeds; at the same time it is an easy one to adjust, and not very sensitive to a small change of setting. The contact points are made from pure platinum-iridium and are substantial in size. The trembler and the spark-gap are placed under the upper lid, and the four terminals, which are completely enclosed, under the lower lid.

The igniter is mounted in a strong wood, weather-proof case, and its insulation is of high quality. The secondary winding is wound in sections, not in layers, thus the electrical strain is evenly distributed. All connections inside the igniter are sweated together. On a 4-cylinder engine the average current taken is 0.75 amp., and on a 6-cylinder engine about 1.25 amp.

THE FARADAY SOCIETY.

At the March meeting of the Faraday Society, Dr. E. J. Russell, F.R.S., Director of the Rothamstead Experimental Station, opened a general discussion on "Basic Slags: their production and utilisation in agriculture." Prof. F. G. Donnan, C.B.E., F.R.S., presided over what proved to be a very fruitful discussion.

The idea underlying the arrangement of the meeting was to bring together the metallurgical and agricultural chemists interested in the subject to enable them to state their requirements and difficulties to one another, so as to facilitate solution of the many complex problems involved. Before the meeting broke up it was keenly felt that the most should be made of so useful—and unusual—a rapprochement between such diverse interests, and a very practical outcome was a decision to form a Standing Committee of agriculturists and metallurgists, and a resolution inviting the Ministry of Agriculture to act as the honest broker in this union, an invitation cordially accepted by Mr. Lawrence Weaver, C.B.E., speaking informally on behalf of the Minister.

The agricultural side of the question: The value of basic slag as an artificial fertiliser, the importance of increasing supplies of it, and the possible demands on the part of the farmer, were comprehensively and lucidly formulated by Sir Thomas Middleton, K.B.E., Sir Daniel Hall, K.C.B., F.R.S., and Mr. G. Scott Robertson. This aspect of the subject must not detain us here, of general interest though it be.

The problem for the steel maker was tersely stated by Dr. Russell: Is it possible to define chemically the constitution of the basic slag of highest agricultural value under various conditions of soil; if so, is it possible either to improve the product yielded by the furnace or else enrich it so as generally to increase its effectiveness? The problem is complicated by the all-important fact that basic slag is, after all, only a by-product for the steel maker, who naturally cannot spoil his steel to improve his slag. The metallurgist's case was stated most ably by Dr. J. E. Stead, Mr. D. Sillars, and Mr. F. Bainbridge, among others, and although no definite conclusions could be determined, broad agreement in certain directions seemed to be reached. For example, it seemed fairly clear that suggestions to improve low-grade slag by additions of phosphate rock to the furnace must be ruled out as impracticable. Less impossible, but still of dubious practicability, is selective tapping of slag, by which the high grade variety (in the open-hearth process) is removed at an early stage in the process. Enrichment during subsequent grinding is quite feasible, and is, of course, practised. A stimulating paper by Mr. W. S. Jones dealt with these phases of the subject.

On the whole, the most hopeful line of advance seemed to be to find out the most advantageous conditions under which the various grades as naturally produced can be utilised, and apply them always where their effectiveness will be greatest. This may seem a very empirical, not to say an unscientific, method; but the whole subject is at present in an empirical state of knowledge. Prof. C. H. Desch discussed the physico-chemical aspects of basic slags, but he was not able to throw very much light on their constitution, and the fundamental question as to what are the valuable constituents is not yet answered. Dr. Desch inclines to the view that they are the calcium silico phosphates, but Mr. C. H. Ridsdale was not satisfied that even phosphorus itself was the magic element, and he adduced reasons worthy of all consideration for supposing that the iron in some unknown form may be a fertilising element—a truly far-reaching suggestion, if it has any stable foundation.

THE COSMOS FLASH LAMP.

The Cosmos Lamp Works, Ltd. (owned by the Metropolitan-Vickers Electrical Co., Ltd.) possesses within its organisation a factory developed expressly for the production of electric lamps of the flash light type. Up to the present time, most of the flash light type lamps used in this country have been imported, but the company decided to make this a home industry, and already tens of thousands of these small lamps are turned out from the factory each week.

The standard flash lamp produced at the works is sold to the public at the recognised price of 6d. per lamp, despite the fact that the rate of wages to workers employed on this work here is some ten times as great as in Japan, whence many of the imported lamps emanate. Furthermore, there is no doubt that the British article is superior to the imported one.

The Cosmos flash lamp factory is situated at Brimsdown, Middlesex, and is equipped upon a modern and efficient basis, the whole process of manufacture being carried on in the works, from the blowing of the glass bulbs onwards.

As in the larger lamps, the drawn-wire filament is mounted on leading-in wires sealed in a flanged foot, as illustrated in fig. 1, the glass being melted around the wires. The bulbs are blown on very ingenious machines from glass tubing in series of eight or ten, as shown in fig. 3 (A).

The bulbs are separated by heat at the point Z, and the mounted foot is inserted as shown in fig. 3 (B) and sealed to the bulb. The piecing or exhausting tube is now joined to the flange as shown in fig. 2. The lamp is next cut from the adjoining bulb at the point Z and the opening sealed over so as to make the bulb complete.

The lamp with a score or so of its kind is now connected to a high vacuum pump and exhausted to a very high degree, the filament being lighted towards the end of the process. The vacuum is determined by means of the well-known McLeod gauge, so as to avoid "bad vac" lamps. When the desired vacuum is attained, the piecing tube is sealed off at the point X, shown in fig. 2. The resulting pip on the lamp becomes hidden within the cap, which at this stage of manufacture is cemented on.

Examination, marking, cleaning, and further tests follow, and then the lamps are packed in boxes ready for dispatch. The finished standard Cosmos flash-light lamps are shown in fig. 4.

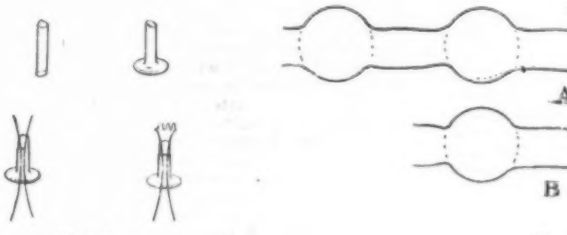


Fig. 1.

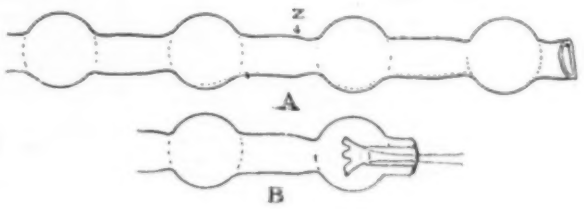


Fig. 3.

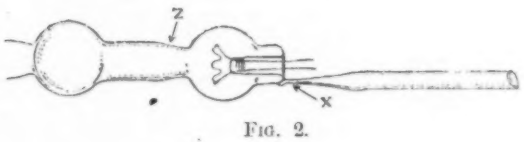


Fig. 2.

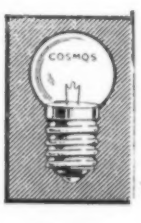


Fig. 4.

Figs. 1, 2 and 3.—Flash Lamp Parts, Showing Method of Manufacture.
Fig. 4.—Finished Standard Cosmos Flash Lamp.

REVIEWS.

Hydro-electric Power Stations. By David B. Rushmore and Eric A. Lof. Pp. x+822, 404 figs. London: Chapman and Hall, Ltd., 1917. Price 28s. net.

Although both the actual and possible development of hydro-electric power in this country are relatively insignificant, the possibilities in other parts of the Empire are so vast that British engineers are well advised to keep themselves conversant with modern practice. The principal literature upon the subject naturally proceeds from countries where the development is greatest and the present volume gives an excellent survey of current American practice with regard to hydroelectric developments. It is descriptive, rather than academic, yet scientific principles are explained and mathematical formulæ presented whenever they are needful to an understanding of the subject. It is in fact a well-balanced treatise which one has no hesitation in commending to anyone interested in hydro-electric plants.

After a very brief, but interesting review of the historical aspect of power development, with a chronological summary of all important land-marks of progress, terminating with the 150,000 volt system of the Pacific Light & Power Co. of Los Angeles, inaugurated in 1913, the available water power of the world is discussed. This is estimated in the aggregate as about 700,000,000 horse-power, of which the United States are credited with an amount of not less than 31,000,000 horse-power, and a maximum of 56,000,000. Of this amount about 6,500,000 horse-power have, so far, been developed, mostly in the States of California, New York, and Washington. In connection with the use of water power for electrochemical processes, the authors give a table showing the KW.H. required per ton (2,000 lb.) in various industries. The fixation of nitrogen is said to require from 15,000 to 60,000 KW.H., the reduction of aluminium, abrasives, and calcium carbide are put at 30,000 KW.H., 7,500 KW.H., and 4,000 KW.H. per ton respectively. The manufacture of pig iron takes from 2,000 to 3,000 KW.H. per ton, and the refining of copper only 300 KW.H. per ton. Unfortunately the source of these figures is not stated, and there is some ambiguity as to their meaning.

A chapter on hydrology includes the methods of gauging streams, and various types of dams and headworks, pipe lines, &c., are then dealt with. The treatment is brief and anything but exhaustive, yet a considerable amount of useful data and information is given. In fact, this last sentence can be fairly applied to the whole work. We have some 37 pages on power-house design, 68 on hydraulic equipment, 370 on electrical equipment, 100 on the economical aspect of hydro-electric undertakings, and a dozen pages or so dealing with organisation and management. It will be seen that the electrical portion of the work is considerably the largest. Starting with a brief discussion of transmission voltages, the authors give a curve which indicates that up to one hundred miles, the most economical voltage may be taken as one thousand volts per mile. The curve then bends over and for 250 miles it indicates 150,000 volts, a voltage which would seem to be nearly the limit from the appearance of the curve. Sixty cycles is the frequency recommended when a lighting load predominates, and 25 cycles where there are to be many synchronous converters on the lines. These two frequencies, of course, are the standards on the other side of the Atlantic.

A good deal of information and numerous formulæ relating to the design of motors, synchronous generators, transformers, reactances, &c., are given, and although no doubt these subjects are dealt with more logically and exhaustively in special treatises on the design of electrical machinery, yet the facts are presented in so clear and readable a form in the present work that one would certainly regret their omission. The authors have a good sense of proportion, and consequently indulge in no more theory than is sufficient to bring out the fundamental principles underlying design. The illustrations, too, are well chosen, representing typical apparatus and standard practice, while the selection of apparatus for description is entirely commendable. As might be expected, quite a large amount of space is devoted to switching equipment and the problems arising out of the protection and safe control of extra-high-tension circuits. The treatment is entirely free from the defect of appearing to exalt the practice of any particular manufacturer, indeed, except when one can recognise the electrical apparatus depicted, there is no clue to the maker's name.

In the chapter on the general economic aspect of possible developments, the authors quote in full the excellent "Guide for the compilation of Water-Power Reports and the securing of Field Data," prepared by Mr. J. T. Johnstone, and printed in the 1914 annual report of the Dominion Water Power Branch of the Department of Interior, Canada. This guide was originally drafted to secure complete and standardised reports from the Canadian field engineers, and it should serve as a model for every engineer who is called on to submit a report on a possible water power development. Detailed costs of construction of various plants are next tabulated, and the items are so particularised that except for the uncertainty as to prices both relative and absolute, at the present time, the figures would be most valuable to any American estimator. The authors are not to blame because prices may have changed enough to detract from the value of their figures, which are presented in admirable form. For example, to take one instance only, the cost of excavating a tunnel, the nature of which is described, is made up of twelve separate items, the cost per cubic yard of each being given. The cost of the concrete lining is subdivided into thirteen separate items, and so on.

The book closes with several appendices. One gives references to descriptions to be found in other publications of apparently every hydro-electric system in the States or Canada. Another furnishes the principal data on over forty transmission systems of 70,000 volts and over, and the last gives the American standard code for testing hydraulic turbines. There is a good index, and the work as a whole is one that can be cordially recommended to those interested in hydro-electric plant.

Modern Electrical Engineering. By Magnus Maclean, M.A., D.Sc. Glasgow: Gresham Publishing Co., Ltd., 1918. Six vols., price 12s. 6d. per vol. net.

This work, in which Prof. Maclean has enlisted the services of twenty-four experts in their respective subjects, affords a striking commentary on the growth of the electrical industry. Owing to this expansion, it frequently happens that information is required on some subject which is indirectly connected with the work in hand, and in such cases these books should prove particularly valuable as a reference library.

They will also appeal to teachers and students who require a good general knowledge of electrical engineering, and to the many engineers who, although obliged to devote their main attention to their own particular work, take a keen interest in everything that relates to the applications of electricity. In view of the fact that the work consists of six large volumes, it will be impossible to do more than give a general idea of the scope and nature of the subjects dealt with.

The first volume opens with the fundamental theory of magnetism, continuous and alternating currents, and their measurement. The treatment of alternating current theory is largely analytical, and assumes a fair knowledge of integral calculus. The descriptions of the different types of measuring instruments are very clear and a useful summary is given for each type, setting forth briefly its advantages and disadvantages for various classes of work.

The design of continuous-current and alternating-current generators is dealt with mainly on the lines of general principles. Some examples from actual practice are given, and the text is illustrated by excellent photographs of modern machines.

A particularly valuable section deals with single-phase and three-phase commutator motors. The principles underlying the design and the advantages and disadvantages of these machines as compared with other alternating-current motors are clearly stated. This section will prove most useful to engineers who are concerned with the use of electricity for motive power, and who are sometimes confronted with the difficult task of deciding on the best type of machine to use for a particular purpose. There is much practical illustrated information on the design of transformers.

The author of this section shows a fine disregard for the conventions by the use of expressions such as "effective $\sqrt{\text{mean}^2}$" for R.M.S., but we must confess to a preference for the more usual form.

The various types of accumulators are described, and the use of boosters is discussed. Much valuable information on the proper care of secondary cells is given, and there are few battery users who would not save themselves trouble and expense by a careful study of the author's remarks.

The section on switchgear has been completely rewritten; it contains descriptions of a large number of modern switches, motor controllers, and alternating-current relays, and is illustrated by excellent photographs. Some line drawings showing details of construction are included, and the number of these might have been increased with advantage.

The chapters on high-pressure transmission of energy contain much information on the latest developments of this subject, and the author has given extensive references to papers and publications.

The design of transmission systems probably lends itself to as much diversity of opinion as any branch of electrical engineering. The author states the rival claims fairly, whilst indicating the conclusions to which his experience has conducted him.

It is rather unfortunate that the section dealing with electric lighting and wiring should have been illustrated by views of obsolete apparatus, such as concentric wall plugs with brass covers, which have been banned for many years.

There is some interesting information on the methods of manufacture of incandescent lamps, and useful curves showing the best efficiencies at which tungsten lamps should be run for various costs of lamps and energy. We should have liked to find fuller information on gas-filled lamps, but possibly this is still within the category of trade secrets.

The major portion of a volume is devoted to electric tramways, and contains chapters on the dynamics of electric traction, general lay-out of systems, the permanent way, rail bonding and welding, overhead and underground systems. The text is well illustrated by line drawings and photographs.

Electric traction on railways is dealt with from the point of view of the fundamental principles underlying this application of electricity. Long-distance lines as well as suburban traffic are considered. An interesting description is given of the methods of signalling employed on the District and other electric railways.

Boilers and prime movers are treated from the point of view of their suitability for use in the generation of electricity, and there are chapters on condensers, air-pumps, water-cooling, economisers, and feed heaters, feed pumps, and the treatment of feed-water.

A section on electrochemistry and electrometallurgy contains an account of the general principles underlying modern practice. The space allotted is somewhat limited, but the more important processes are well described and illustrated.

The chapters on telegraphy open with a description of the line plant in use by the British Post Office. Instruments are next dealt with, and a very clear description is given of the Wheatstone automatic and the Hughes and Baudot printing telegraphs. Radio-telegraphy is hardly treated in accordance with the importance of the subject at the present time.

The section on telephony describes the standard practice in manual exchanges, and also contains a chapter on automatic exchanges. The latter, though excellent in itself, can hardly be taken as a guide to modern practice. The most recent development of automatic telephony, in which all connections are made by relays, is merely mentioned.

Descriptions of apparatus employed in the coal mining industry, and of electric cranes and hoists, complete the series.

The editor and publishers are to be congratulated on the excellent style of the volumes. The print is clear and the illustrations are exceptionally good. Each volume has a separate index, and there is also a good general index.

The names of the contributors are, in themselves, a guarantee of the excellence of the work, which should find a place on the shelves of all engineers who desire to have information on the standard practice in all branches of the electrical industry in a handy and accessible form.

PROTECTION OF A.C. SYSTEMS WITHOUT THE USE OF SPECIAL CONDUCTORS.

At Newcastle-upon-Tyne, on March 8th, the paper by Major Kenelm Edgcumbe, R.E. (T.), an abstract of which appeared in our issue of February 20th, 1920, was read and discussed before the North-Eastern Centre of the Institution of Electrical Engineers.

Mr. Porter, who greatly appreciated the paper, said that Major Edgcumbe apparently had in mind rather smaller undertakings than those which were to be found in the Newcastle district. While he might criticise some of the things that the author had said, he, nevertheless, thought that the writer had given them something that was badly needed in a great many cases. Regarding small schemes, however, he thought the only way to tackle the subject was to approach it in the light of a scheme that might perhaps become a large one. In introducing protective gear there were generally two problems to be considered, the first being to make it impossible to damage apparatus, and the second to ensure the maintenance of the continuity of supply. If they were putting in gear for the second reason, then the "risk" was a double one, so they ought to be prepared to pay more for such an insurance policy than for one which provided for the protection of a single factor. Indeed, on a large system it would pay to put in more protective gear; it generally paid better to give attention to continuity of supply than merely to have regard to prevention of damage. With regard to the latter consideration, there was the time factor to be considered—there was a period at the end of which, whatever that time was, damage would accrue—but if they had more extensive protection it might remove the fault and save damage to the plant, although the gear had been installed with a view to ensuring continuity of supply. Speaking of the time limit, the speaker said that if they had instantaneous action it would clear the fault before it became a "short." They did not get any advantage from time-lag unless the fault started with a "short," which usually it did not. In small schemes where there was one power station and a few sub-stations, discrimination might answer, but in such cases as that district where there were 400 sub-stations, the position was vastly different. He thought that discrimina-

tion by time-lag or by direction of current was only of limited applicability. These were all questions that each one should face for himself. For instance, where they had continuous processes going on it was a serious matter to have an interruption of the supply, and it might be worth while to have adequate protection. He pointed out that some protective methods hampered extensions.

Mr. H. W. Clothier was glad to hear that the author did not put forward his proposals as a solution of the problem for large systems, and he hoped that that would be emphasised, as otherwise the paper might seem to belie his intention. He thought it was Major Walters who set himself the difficult problem of solving the question of parallel feeder protection. In those cases it was necessary to make sure that the feeder they tripped out was the faulty one, for it was not always the faulty feeder that carried the greatest current. The author made a very good point when he suggested that in the case of sub-stations fed by a large number of parallel feeders, or from two sources by independent pairs of such feeders, it might sometimes be possible to treat the pair as a single unit, and to isolate both on the occurrence of a fault on either. The author's proposals for the protection of inter-connectors and ring mains were open to criticism, and the speaker referred to the diagrams showing protection by what the author called reverse relays; he did not think these should be called reverse relays, they were operated by potential in one direction, and he thought they should be called, perhaps, unidirectional relays. A question suggested by several parts of the paper was: How long was it permissible to allow a fault to stop on a system? One objection was that if faults were allowed to run on, synchronous plant would get out of step. He had heard that 0.5 of a second was possible for the duration of a "short" on a system without any danger of the synchronous plant getting out of step, but the figures given varied so much that it would be well to know the point definitely.

Mr. J. R. Beard said there were some mis-statements in the paper that he thought should be modified. In the first sentence the author spoke of the subject as "one of the most pressing of the moment." The speaker did not think it was pressing in a general sense; they knew from actual every-day experience that the problem had been solved, not perhaps in the most economical or perfect way, but it had been solved, and protection afforded in an efficient manner. He pointed out that the methods named were not the only ones; Glasgow, he believed, was without any protective gear until last year, and they rearranged their network for protection, and were fairly satisfied, he understood, with the change. He thought they did not want to omit any of the requirements mentioned by the author, but there were other points also to be noted. The speaker referred to the author's criticism of the Merz-Price system which acted in "watertight compartments," and claimed that this feature was a great advantage—it was complete protection.

Mr. Collins said that at various points throughout the paper attention was drawn to the effect of faults that might arise instantly, and he thought it was suggested that these faults should be removed as quickly as possible, while not going in for the principle of instant isolation.

Dr. Bowden drew attention to the question of earthing through reactances, a method adopted largely by Petersen in Germany. It was worthy of consideration.

Major Edgcumbe replied, and with regard to the last suggestion, said it could not be applied to the cases with which they were dealing.

At Edinburgh, on March 9th, Major K. Edgcumbe's paper was read and discussed before the Scottish Centre of the Institution of Electrical Engineers.

Prof. Bailey agreed with the author's view that protection devices worked from the cable itself had distinct advantages over those with separate cables. The little cables were more liable to break down than the big cables they were intended to protect, though not subject to the high voltages of the latter. In overhead lines particularly, he thought there was much more likelihood of the protective device breaking down.

Mr. Charles W. Marshall said that while the author pointed out the advisability of not breaking circuits at the time of maximum current, he (Mr. Marshall) thought it advisable to stake everything on an attempt to clear faults before they developed between phases. The most obvious way of doing this was by increasing the speed and sensitiveness of the relays and switches. This was especially desirable in systems which included synchronous converting machinery. He did not share the author's regard for the induction relay, as he had found it to be subject to the troubles of all instruments using jewels and pivots, and in addition the time calibration was liable to alter, due to the magnetising action of the alternating field produced under short-circuit conditions. The example chosen to illustrate the author's view that biasing was valueless did not represent practical conditions. Unbalancing of 5 per cent. could never be tolerated, and it was generally quite easy to balance within 0.5 per cent. Biasing to that extent was quite satisfactory. The biasing problem was closely analogous to that of compensating induction watt-hour meters. In these instruments, if the design was sound a fair degree of accuracy could be obtained without the use of compensating devices, and using these the accuracy could be very high indeed. On the other hand, if the meter was bad to begin with no amount of compensation could do it much good. In general, the methods of protection proposed by the author might be interesting to existing undertakings where special provisions could not readily be made, but he thought that much more general methods should be adopted in new systems. The schemes proposed by Whitaker and M'Coll seemed to him to be worthy of the closest investigation in this respect.

Mr. A. E. M'Coll did not see how any reasonable degree of protection combined with continuity of supply was possible on complicated systems without the use of special conductors. He did not mean to say that the author's methods would not find application on large systems, but he did not think they represented a general solution of the problem. In dealing with the protection of independent feeders, leakage relays were advocated in conjunction with overload relays. The author had omitted all mention of combined leakage and unsymmetrical loading devices, which gave instantaneous protection against faults between any two phases in addition to earth faults. A number of devices had been developed for this purpose, and these should find a ready field of application to the cases of individual feeders and isolated rotary plant. The author advocated delaying the action of overload relays so that on a short circuit between phases the energy of the system might be partially dissipated before the switch was called upon to interrupt the circuit. This was given as a good feature of the overload relay. The speaker thought it a distinct failing. He had always held that there was a field for an overload relay having a double characteristic, *i.e.*, a definite or partially inverse time function up to a point, and beyond that the relay to be instantaneous in action. One such relay had been put on the market by a certain manufacturer, but he was not at all convinced that the mechanical features of the device were satisfactory. It was a simple matter to install devices which would operate with faults irrespective of their location; it was a different matter, however, to make them discriminate correctly on a large and complicated distribution system, and this was where the systems of protection which employed pilot wires and specially constructed cables scored. He agreed that separate current transformers should be employed for operating the protective gear and measuring instruments. On the score of economy some manufacturers were putting two secondary windings on one magnetic core, one winding for the protective-gear circuits, and the other for instruments. It might be well to sound a note of warning with regard to such an arrangement. It was not safe to interrupt the protective gear circuits especially where the balanced current system was employed, and, moreover, it was equally disastrous to break the instrument circuits where transformers with double secondaries were employed. In this case it simply meant that if one winding was broken the other winding carried double current. For parallel-feeder protection the author advocated the employment of overload and leakage relays for the end adjacent to the source of supply. It seemed to the speaker that this parallel feeder arrangement might be fully protected by employing interlocked discriminating relays, which gave instantaneous protection, either with faults to earth or between phases. The only difference was that lower values of resistance were required for the neutral earth. Time lags for leakage relays on parallel feeders should not be necessary. He admired the ingenious arrangement of the author to obtain a flat characteristic for the relay down to fairly low potentials across the pressure coil. The speaker had obtained somewhat similar results with reactive type relays without the compensating winding. Transformers protected by Merz-Price gear should not be disconnected by the charging current when switched into circuit. This could be taken care of by simple means without resorting to fuse-shunted relays. He agreed with regard to the good features inherent in devices operating on the biased principle. When the biasing action was performed by a coil of the open plunger type whose pull would increase roughly as the square of the current, the operating torque for the relay was given by two quantities which might move in diverse directions under severe emergency conditions. It seemed, therefore, that the bias might increase under these conditions to a value which was actually unsafe. He was in agreement with the author on the best connection to be adopted for reverse relays, and should say that any other than that advocated was distinctly unsafe. He did not agree that the reverse relay in its usual form was the best means of protecting generators and transformers. The reverse relay to be operated demanded a plurality of plant on the bus-bars to give the necessary reverse flow. It was equally necessary that the protective device should operate in the case of a fault even should there be no reverse flow possible. Systems of generator protection had recently been developed which employed directional relays and which combined the functions of the differential system with the usual characteristics of the reverse current relays. This system was on the market now, and particulars should soon be available. He was in agreement with regard to earthing the neutral through resistance. If pure reactance was employed the phase shift with faults to ground might be sufficient to render the reverse relays on the faulty feeder of a pair of parallel feeders inoperative. With the author's schedule of minimum current in the earthing resistances he did not agree, particularly so in the case referring to parallel

feeder protection. If they wished to have any discrimination between the relays at the power supply end sufficient to bring out the switch of the faulty feeder first, they must pass through the earthing resistance something more than twice the full load of the feeders.

Mr. E. Seddon, considering the short-circuit currents possible with the very large circuit currents used to-day, asked if it would not be better first to limit the flow of current by quickly opening a circuit breaker across which would be connected a reactance, and afterwards disconnect the faulty circuit by a second switch placed next to the bus-bars. This switch would also operate direct on single-phase leakage. This entailed two oil switches in series, but with such an arrangement they might be able to get something like standard switchgear. For independent feeders, he agreed with the author that leakage protection was the best arrangement of present-day practice, except that he preferred the fuse-shunted solenoid to mechanical movement of dashpots. As to the protection of closed feeders, the best arrangement was to protect all closed feeders independently of any other feeder, which could be done either by Merz-Price or split-conductor protection. The latter was preferable in all but very short feeders. The author referred to the high voltage being induced in exciter windings. He had experienced this on one or two occasions, and considered the practice of adjusting exciter brushes when a turbo set was on load was to be condemned unless an insulated stool was provided.

Mr. A. P. Robertson agreed with bringing about the opening of the circuit as early as possible if there was any fault, and he thought they should concentrate upon getting a maximum speed of opening with a system where there was a lot of synchronous machinery.

Mr. Henriker described the fuse time limit as the most satisfactory of all. He suggested 5 per cent. of normal F.L. current as a reasonable earth fault which could be left on a system. He considered that the two most important factors were maintenance of continuity of supply and the reasonable assurance that a faulty section would be cut out.

STANDARDISATION RULES FOR ELECTRICAL MACHINERY.

At Birmingham, on February 11th, an informal discussion took place on the British Electrical Standard Specification No. 72 before the South-Midland Centre of the Institution of Electrical Engineers. Mr. A. R. Everest, M.I.E.E., opened the discussion, of which an abstract follows:—

Mr. A. R. Everest said that following a long period of enforced inactivity due to war conditions, the International Electrotechnical Commission had resumed its activities, and as a result, many of the essential points which were still unsettled in the I.E.C. rules had been settled, and the first volume was in the printer's hands. The general plan was that the I.E.C. rules should establish the essential principles as internationally agreed, the various countries participating then each preparing its own set of national rules embodying the principles laid down by the I.E.C., and a new edition of the British Standardisation Rules, E.S.C. 72, would be undertaken in the immediate future. It was now well known that a machine when given the "British Standard" continuous rating, was rated for the highest load which it could carry for an unlimited period without exceeding the limits of temperature-rise allowed by the rules. There had been much misconception regarding the feasibility of allowing a machine so rated to take overloads in excess of its rating. The I.E.C. rules were now so worded as to show clearly that the rating was a test rating, for comparison purposes, and with regard to service conditions, the only limitation found in the rules was that the machine should not be subjected to any loads which caused it to acquire a temperature-rise higher than that allowed under the test condition. Clearly a machine when starting cold could take a very considerable overload while still keeping within this limit, but undoubtedly there were dangers associated with very excessive overloads. Against these dangers there appeared to be at present no safeguard in the British rules, which imposed no restriction on overload except in terms of temperature-rise. It appeared desirable, therefore, that there should be an agreed limit to the magnitude of the sustained overload to which a standard machine might be subjected. With regard to momentary overloads, the I.E.C. rules now recognised that when the overload peaks in service exceeded the values agreed as suitable limits for a standard machine, such service would demand a special machine with a special kind of rating. In the case of a standard machine, therefore, it would appear desirable to establish recognised limits to the magnitude of both the sustained and momentary overloads. For this purpose it had been suggested that a sustained overload of 25 per cent. for half an hour should be recognised for all motors not smaller than 5 H.P. This was subject to the rule that the standard temperature-rise must not be exceeded, but it was considered that the need for such overload margin occurred chiefly when a cold motor was starting cold machinery. With regard to short-time ratings, the method of rating provided in the rules corresponded with that which had been the general practice for some time past. The "British Standard" rating (with its associated limit of temperature-rise) was, by the rules, suitable for use in connection with cooling air of a temperature not exceeding 40 deg. C. (104 deg. F.) as a maximum. The need for additional ratings suitable for use under tropical conditions on the other hand, had been discussed. It was proposed to establish a tropical rating with an appropriate higher limit to the maximum temperature of cooling air. With regard to machines intended for cool countries, it was pointed out that these when used indoors were generally working under conditions not very different from those in temperate countries, and it was recommended that no special modifications should be made for such cases. Those unusual cases in which a machine would certainly be required to operate always under abnormally-low cooling conditions should be regarded as quite special, and designs made accordingly. The general rule for all such special designs would be that when tested under rated load the temperature-rise should be such that when added to the temperature of the cooling conditions contemplated, the highest temperature obtained must not exceed the limits of total temperature indicated in the rules. Another feature of considerable interest was the method recognised for measuring temperatures. The requirements of the earlier editions of the rules, that temperature-rise measurements of field coils and similar windings should always be by the resistance method, had been regarded as impracticable, particularly regarding small machines produced in large numbers. This objection had been met in later editions of the rules by permitting these measurements to be made by thermometer alone, provided that readings so obtained were consistent with the limits assigned to the resistance method, as shown by complete tests taken on a few typical machines. There was a strong feeling that for turbo-alternators, and for other large and important machines, the temperature-rise should be determined from measurements made by embedded temperature detectors built into the machine at points so selected as to give indication of the internal temperature. The last (1917) edition of the British Standardisation Rules, No. 72, recognised the advantage of these devices, but the I.E.C. had not as yet formulated definite rules. It had submitted for the consideration of the British and other national committees a proposal on the following lines:—

"That for the acceptance tests of large rotating machines the temperature should be measured by the embedded temperature detector method for parts where this method would be applicable."

It was not considered that the method would be applicable to any moving parts, but that it would be applied to windings in slots on the stationary part of a machine, the embedded temperature detectors being placed between coil and adjacent slot wall, and between coil and coil in the slot, in each case being outside the coil insulation. (The insertion of embedded temperature detectors within the insulation of the coil, adjacent to the copper, was not considered feasible for commercial tests on account of the risks involved, such measurements belonging essentially to research tests.) The proposal was that this method of temperature measurement should be employed for the stationary windings of machines meeting the foregoing conditions when such machines were wound for more than 5,000 volts, or were rated for an output exceeding 750 K.V.A., or if the stator cores exceeded 20 in. axial length. The proposal contemplated that the method also might be applied to the windings of large transformers, provided this was specified in the contract. The recognition of this method of temperature measurement for the acceptance tests involved also the establishment of limits proper for the temperatures when so measured, and the British Committee was arranging to collect evidence with a view to forming conclusions upon this important point. There was little that was essentially new in connection with high-pressure tests; while the one minute test still remained as the standard, suggestions had been made regarding the desirability of substituting one or more briefer tests of higher value, allowing time between such tests for the insulating material to return to its normal condition.

Dr. M. Kahn said that Mr. Everest's notes cleared up a number of controversial points and foreshadowed a revised edition, which contained several important improvements. It would be of considerable help if, together with the new rules, a complete series of explanatory notes of the various regulations and recommendations could be issued. The present rules did not contain any standard tests which were necessary to ascertain whether electrical machinery complied with the guarantees and specifications given in connection with it. This referred more particularly to efficiency and power factor, which could be determined in various ways. Standard margins which could be allowed in connection with these guarantees could also be embodied in the rules on the lines of the recommendations of the B.E.A.M.A. The proposed extension of the rules for temperature measurements on large generators by thermo couples or resistance coils was a step in the right direction. In large modern turbo-alternators, where the eddy current loss in the stator conductors was reduced by suitable means, the temperature gradient between conductors of a two layer winding was small, and if a temperature detector was inserted between the top and bottom coil of such windings, it would indicate the temperature rise of the conductors pretty closely, although

it was not in direct contact with the copper. Alternatively such detectors might be placed between the coil and the wood or fibre wedge closing the top of the slot. As the heat conductivity of the wedge was low the temperature gradient between the copper and outside of the insulating tube was not appreciable at that point. If the neutral of the alternator was earthed a few detectors could be inserted inside the mica tube close to the copper conductors in the coils which were direct connected to the neutral point, where the voltage to earth was in consequence low. The readings obtained on these detectors could be compared with the readings of detectors placed outside the insulating tubes for comparison and the leads of these detectors could then be cut off where they came out of the stator coil if that appeared desirable. The questions arising in connection with self-starting synchronous motors deserved greater attention. In clause 6 of the rules the starting torque required and the starting current which could be allowed were omitted from the lists of information required with inquiries for such machinery. Clause 93 did not mention that the pressure induced in the rotor windings entirely depended on the pressure applied to the stator terminals when starting. If a certain ratio of this pressure to the full stator voltage had been assumed this ratio should be given with directions how the test pressures were to be altered in case a different ratio was employed. In clause 93 (*b*) a rough division was made in two classes of motors of exciter pressures above and below 250 volts. A further grading of test pressures depending on the exciter voltage seemed appropriate.

Mr. H. W. Taylor thought that British engineers might find it difficult at first to appreciate the new method of rating, but he thought it should be borne in mind that inasmuch as the conditions under which motors were used varied widely, and as the number of cases in which a machine was required to exert a continuous effort were few, any method of rating might be considered as a nominal one, on which the machine might be tested. It was proposed to standardise the inlet temperature as 40 deg. C. for British work, but it would seem that this figure was rather conservative. With regard to the rating of large machinery (more particularly of large turbo generators), he believed it would be the custom in the future for purchasers of such machines to specify, first, the actual inlet temperature with which the machines were expected to operate, and secondly, that under these conditions the maximum internal temperatures should not exceed those specified by the International Standardisation Rules. In this way the purchaser would not be expending an unnecessary amount of money on a large machine rated on a standardised inlet temperature which was higher than his own normal conditions. Temperature detectors, however, would be installed in such machines, so that the maximum load on them could be graduated to temperature variations from the normal. In tropical climates, the use of a wet air filter helped considerably in reducing the initial temperature at which the air entered the machine. Advantage might be taken of this fact by operating engineers in determining the inlet temperatures at which such machines would normally operate.

Mr. R. Orsettich thought that one of the advantages of the new rating would be in connection with machines which were not likely to require an overload margin, such as fans, compressors, &c. In all such cases it would be possible to select a machine which would work at the maximum load required, and it would, therefore, work with a considerably higher efficiency than was usual at present. Apart from this, in the case of A.C. motors, the power factor would be considerably increased, as the motor would be less likely to work under-loaded than at present. The standard frequency was 50 cycles; in view of the fact that two very large industrial districts in this country were supplied with power at 25 cycles, and that similar large supplies were established in Canada and Australia, it seemed desirable to consider the adoption of 25 cycles as a second standard frequency. The standard pressures for D.C. motors did not include 550 volts; as a large number of motors were continually required for traction systems, it seemed desirable that this additional pressure should be included. The short-time rating had given rise to several misunderstandings, as there was no explanation how this rating could be used in practice. The wording of clause 59, concerning the duration of temperature tests for machines with continuous rating, appeared somewhat doubtful, and it was suggested that, in order to reduce the duration of the test, a temperature gradient should be stated of, say, 1 deg. C. per hour, and that when this was reached, the test could be finished by making an allowance for the additional temperature. It appeared desirable that besides the frequency the output of the generator used for the pressure test should be given. The items specified to be given on every nameplate were so numerous that it would be difficult to accommodate them on a nameplate of reasonable size.

Mr. A. T. Bartlett said that the specification was remarkably complete; he was glad to see that there was no mention of the pernicious "flashing" test. He understood that it had been very deliberately decided to allow no tolerance in the matter of temperature rise, but he did not agree with this. There were errors of observation in measuring temperatures which were always present even when such tests were made under laboratory conditions. He agreed with Mr. Everest concerning the importance of an international specification as helping international trade. Another reason for such a specification was that it would become the only specification and thus free designers from having to deal with fancy specifications. The specification was not intended to limit in any way the actual duty a machine had to perform.

Mr. E. J. Kipps said that according to the rules, motors for intermittent work had a short time rating of either one hour or 30 minutes for temperature, and were to be capable of withstanding on test for 30 seconds a torque 100 per cent. in excess of that corresponding to their short-time rating. The difficulty of fixing a time for a continuous run at full load, which should give the same temperature rise as the same load on intermittent runs, was evident. Thirty minutes was too long for a continuous run for small motors on loads which they could carry satisfactorily on intermittent work with running time of two or three minutes. A short time rating of 15 minutes appeared to cover all cases of crane motors used in practice. For the increased load, which a certain motor could carry on a 15-minute rating, as compared with its load on a 30-minute rating, there would be a large increase in the temperature gradient between the copper wires and adjacent parts of the motor, but if the temperature of the armature and field windings was determined from the increase of resistance, there seemed no objection to a short-time rating of 15 minutes or even less. Presumably a test under short-rating conditions would not be repeated before the motor had time to cool down to atmospheric temperature.

Mr. N. Joseph endorsed the remark of Dr. Kahn that it would be of considerable utility if the specification in its final form included some standard of efficiency for motors. He suggested a table of efficiencies for varying sizes of D.C. and A.C. machines. He thought it essential that stress should be laid on the necessity for the name plate showing the rotor current of slip-ring motors, and he would add, the field current of all D.C. machines.

Mr. R. G. Jakeman said it was not clear why commutators and slip rings were only allowed a maximum temperature of 90 deg. C., while the maximum permissible temperature for mica was 125 deg. C. With regard to field coils, the maximum actual temperature was 105 deg. C., and the maximum temperature by resistance 95 deg. C. The difference took into account the fact that the mean temperature rise was measured by resistance, and he would like to know if it allowed for the deepest coils met with in practice; 10 deg. C. difference seemed rather high for the ordinary thin coils on large machines. In the list of particulars to be given when ordering machines, rotary converters were omitted.

Mr. A. R. Everest, in reply, said he would see that Dr. Kahn's suggestion regarding the free use of explanatory notes in the new edition of the rules should reach the proper quarters. With reference to the suggested introduction of embedded temperature detectors within the inculating tube and adjacent to the copper conductors, it was doubtful whether such methods ought ever to be admitted for the commercial tests to which the Standardisation Rules essentially applied. With regard to the suggestion that the subject of test pressures for the field windings of synchronous motors needed further consideration and sub-division, the clause in question was the result of much careful consideration both by the B.E.A.M.A. and the Rating Committee, but any further considered recommendations from the B.E.A.M.A. would receive every attention. Several considerations seemed to be involved in the suggestion that by utilising embedded temperature detectors in service, the output of a large turbo-generator might be controlled with reference to the maximum permissible limit of temperature. In tropical countries the air when at the highest temperature was frequently at the same time highly saturated with moisture, so that little reduction in the temperature of the cooling air would result at such times from the use of the wet filter. With regard to increased output to be obtained in winter time, it must be remembered that the output available from the prime mover was, at most, only a few per cent. greater in winter than in summer, therefore it was not easy to see how any larger increase in output of the generator made possible by abnormally low temperature could be utilised. Better attention given to the selection of motors with respect to duty required was certainly desirable. Regarding the short-time rating, that was a rating established for test purposes in which a specified load was applied to a machine for a specified time, starting cold. Machines rated in that way were employed particularly on intermittent service, and it was necessary that for any particular service a short-time rating should be selected which was thermally equivalent, *i.e.*, gave the same temperature rise as the intermittent load of service conditions. When a customer did not know from past experience which rating was suited to his particular service, the engineer-salesman should be able to advise. Possibly some explanatory note which would be of assistance might be added to the rules. Regarding the duration of temperature tests for machines with continuous rating, the present rule assumed that the shape of the temperature curve would be plotted and its ultimate value thereby predicted. A note explanatory to the rule might be of assistance in this matter. He was glad to hear the remarks regarding the assistance which might be expected in international trade by the adoption of an internationally agreed basis of test rating. The temperature limits given in the International Rules were expressly defined

as being themselves the "maximum values"; hence, if a tolerance was to be employed it must be based on such lower value that with the tolerance added the "maximum" was not exceeded. Referring again to the short-time ratings and the suggested addition of a 15-minute rating to the standards recognised, if the makers agreed to its desirability there should be little difficulty with regard to its recognition. A table of standard efficiencies for various sizes of A.C. and D.C. machines was a matter which was largely in the hands of the makers themselves. If they were to agree upon the values of the efficiency suitable for the purpose, such lists might be usefully included in the rules. It was expected that the revised British Rules would embody a clause recently introduced into the International Rules, which permitted commutator temperatures higher than the usual limits, subject to special guarantees which were to be given regarding the performance.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

9,080. "Device for suspension of glass illuminating bowls from electric-lamp holders." C. H. Barker. March 29th.

9,083. "Electrically-heated incubator." W. J. Anderson. March 29th.

9,089. "Circuit-conducting means for electrically-operated apparatus within gimbal-supported casing, &c." R. L. Davies and R. D. Metcalfe. March 29th.

9,099. "Receiving circuits." Western Electric Co. March 29th. (United States, January 5th, 1916.)

9,103. "Device for tilting shades of electric lamps." W. J. Markham. March 29th.

9,107. "Electric ovens." C. H.-Lauth. March 29th.

9,127. "Automatic signaller for wireless telegraphy and telephony." R. E. Gray. March 29th.

9,141. "Electric switches." P. Rubert. March 29th.

9,165. "Antiseptic telephone mouthpiece attachment." A. T. Hutchinson. March 30th.

9,180. "Means for obtaining electricity from the atmosphere and uses for the same." H. Gough-Turner. March 30th.

9,221. "Electric heating and cooking apparatus." J. J. J. M. Kluytmans. March 30th.

9,222. "Oscillation generators." Western Electric Co. March 30th. (United States, June 1st, 1915.)

9,223. "Electrical transmission systems." Western Electric Co. March 30th. (United States, May 18th, 1914.)

9,225. "Telephone systems." Automatic Telephone Manufacturing Co. March 30th. (United States, May 28th, 1919.)

9,236. "Manufacture of incandescent lamps." Westinghouse Lamp Co. March 30th. (United States, April 3rd, 1919.)

9,238. "Protective apparatus for multi-phase alternating-current circuits." Metropolitan-Vickers Electrical Co. March 30th. (United States, April 4th, 1919.)

9,251. "Electrolytic deposition of iron and treatment of deposits." H. Lovelock and T. Try & Son. March 30th.

9,264. "Morse-tapping instruments." J. H. Hansen. March 31st.

9,273. "Electric switches to prevent starting of internal-combustion engines." R. E. A. Akers and W. H. Briscoe & Co. March 31st.

9,279. "Means for electrically detecting or estimating dissolved matter or impurities in water, &c." A. W. Empson. March 31st.

9,326. "Electric transmission systems." Western Electric Co. March 31st. (United States, February 1st, 1918.)

9,337. "Electrical fuse-holders." A. H. Maxwell and F. Shergold. March 31st.

9,341. "Processes and cells for electrolytic decomposition of alkaline salts." M. Wilderman. March 31st.

9,345. "Varying field strength of electric machines." Siemens Schuckertwerke. March 31st. (Germany, April 26th, 1917.)

9,346. "Control of field strength of electric machines." Siemens Schuckertwerke. March 31st. (Germany, June 7th, 1917.)

9,347. "Terminal and sparking-plug tester." J. Davies and E. Lyons. March 31st.

9,352. "Protective devices for electric circuits and apparatus." British Thomson-Houston Co. (General Electric Co.). March 31st.

9,373. "Fittings for electric, gas, &c., lighting." A. G. Beaver and The Sun Electrical Co. March 31st.

9,389. "Electro-magnetic induction micrometers." J. M. Ford. March 31st.

9,433. "Thermionic relays or amplifiers." G. A. Mathieu. April 1st.

9,437. "Electrolytic rectifiers." H. Leitner. April 1st.

9,438. "Propulsion of electrically-propelled vehicles or trains." A. Kaworth. April 1st.

9,445. "Electrolytic treatment of ores containing zinc, &c." Electrolytic Zinc Co. April 1st. (Australia, April 4th, 1919.)

9,446. "Electrical indicators." British L.M. Ericsson Manufacturing Co. and W. M. Crowe. April 1st.

9,452. "Cooling electrical apparatus." G. Schroeder. April 1st.

9,453. "Means for carrying off heat generated in electrical apparatus." G. Schroeder. April 1st.

9,460. "Dynamo-electric machines." G. A. Juhlin and The Metropolitan-Vickers Electrical Co. April 1st.

9,483. "Compound anode for electro-plating and method of making same." C. R. Dean. April 1st. (United States, December 12th, 1917.)

9,487. "Magneto-electric machines." British Thomson-Houston Co. and A. P. Young. April 1st.

9,492. "Sparking plugs for aero-motors, &c." A. Custoza. April 1st. (Italy, April 1st, 1919.)

9,496. "Self-supporting induction coils." De Forest Radio Telephone and Telegraph Co. April 1st. (United States, April 4th, 1919.)

9,519. "Lighting-magnetos for cycles, &c." Soc. Anon. La Magneto Belge. April 1st. (Belgium, October 2nd, 1919.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

10,455. Electro-osmotic process for removing water from materials. Elektro Osmose Akt. Ges. (Graf Schwerin Ges.). October 20th, 1917. (135,817).

18,321. Automatic regulating systems for dynamo-electric machines. British Thomson-Houston Co. (General Electric Co.) November 8th, 1918. (139,836.)

20,759. Magneto ignition systems. Compagnie Generale de Magnetos. August 31st, 1918. (132,282.)

21,831. Electric furnaces. E. Fenton. June 21st, 1919. (139,843.)

1919.

1,464. Electric terminals. G. J. Parker and G. A. Parker. January 20th, 1919. (139,849.)

2,361. Electric lamp sockets. G. Frankel. January 30th, 1919. (139,855.)

3,158. Telephone instruments. Western Electric Co. and V. Amberg. February 8th, 1919. (139,861.)

3,835. Methods of using three-electrode ionic tubes, applicable for wireless telegraphy and other purposes. L. B. Turner. February 17th, 1919. (139,867.)

4,709. Alternating current limiting apparatus. S. Salto. February 28th, 1918. (123,766.)

4,791. Circuits of incandescent lamps. A. H. Railing and C. C. Garrard. February 26th, 1919. (139,876.)

5,119. Heating by electrical means and to any desired temperature metal rings or bands of any shape or size. H. S. Binns. March 1st, 1919. (139,881.)

6,024. Step-by-step mechanism for electric motor-starters. A. H. Railing, C. C. Garrard and W. Wilson. March 11th, 1919. (139,889.)

6,025. Trolley heads of electric tramcars and the like. R. J. Clarke. March 11th, 1919. (139,890.)

7,032. Connecting-devices for electric circuits. Remy Electric Co. April 22nd, 1918. (125,943.)

7,181. Electrical switches. J. W. Haran and H. C. Tofield. March 22nd, 1919. (139,897.)

7,501. Automatic switching apparatus for telephone exchange systems. Western Electric Co. (Western Electric Co.). March 25th, 1919. (139,900.)

8,286. Holders for wireless detecting crystals. W. P. Thompson (V. J. Brochard). April 2nd, 1919. (139,904.)

8,609. Cable conduits for electric travelling cranes. C. L. Browne and S. H. Heywood & Co. April 5th, 1919. (139,913.)

8,863. Rheostats. F. C. Curtis. April 8th, 1919. (139,915.)

9,284. Automatic welding devices. British Thomson-Houston Co. (General Electric Co.). April 11th, 1919. (139,919.)

10,065. Sparking plug. W. G. Clayton. April 22nd, 1919. (139,933.)

11,427. Cables for electrical machines adapted to be coiled and uncoiled. Electro-Agricultur. Aktiebolaget. June 7th, 1918. (127,812.)

14,111. Preparing aluminium or its alloys for electro plating. H. D. Cunningham. June 4th, 1919. (139,967.)

14,680. Electric switches. R. L. Murray and Telephone Manufacturing Co. June 10th, 1919. (139,972.)

14,776. Electrically-heated laundry irons. F. Angell and H. Angell. June 11th, 1919. (139,973.)

15,342. Methods of indirectly coupling a radio-telegraphic antenna to a high-frequency alternator. March 15th, 1918. (128,575.)

17,422. Electrical signalling apparatus. M. J. Railing and J. J. V. Connoughton. July 11th, 1919. (139,994.)

18,005. Sparking plug for internal-combustion engines. E. Piquerez. December 18th, 1918. (136,798.)

The A.C. Commutator Motor. — The A.C. commutator motor in its various forms has been developed principally for the purpose of obtaining adjustable or variable speeds. In general, control of speed with the A.C. induction motor implies variable or adjustable frequency in some form, and this, in turn, involves a commutator of some type. In consequence, the problem of commutating A.C. usually goes hand-in-hand with that of speed control. The simplest method, according to the author of a paper on this subject in the *Journal* of the American I.E.E. for March, 1920, for viewing both the A.C. and D.C. commutating problems, is to consider primarily the actual E.M.F.'s short-circuited by the brushes, and the resistance in the short-circuited paths, *i.e.*, the problem is largely one of the permissible amount of short-circuit current. In the D.C. machine the E.M.F. short circuited by the brushes is that generated by rotation of the short-circuited armature coils in the armature and external field fluxes. In the same way, in the A.C. commutator motor, there is an E.M.F. due to the armature flux or field, as in the D.C. machine, and in addition there are other E.M.F.'s due to the primary or field fluxes. The latter may be classified as primary rotational and transformer E.M.F.'s. One limitation in the design of A.C. commutator motors, in general, is that these rotational and transformer E.M.F.'s are often larger in degree than the E.M.F. due to the armature flux. However, the author contends that the commutation problem in A.C. motors is the same as for D.C. when all E.M.F.'s are taken into account. The major part of the paper covers the consideration of the different E.M.F.'s which should be taken into account in the various types of A.C. commutator motors, and it is shown in a general way that the E.M.F.'s involved in speed control also appear in the commutation problem. In the latter part of the paper certain general conditions of commutation and brush operation are treated, and some figures are given for comparison of A.C. and D.C. commutating limits.